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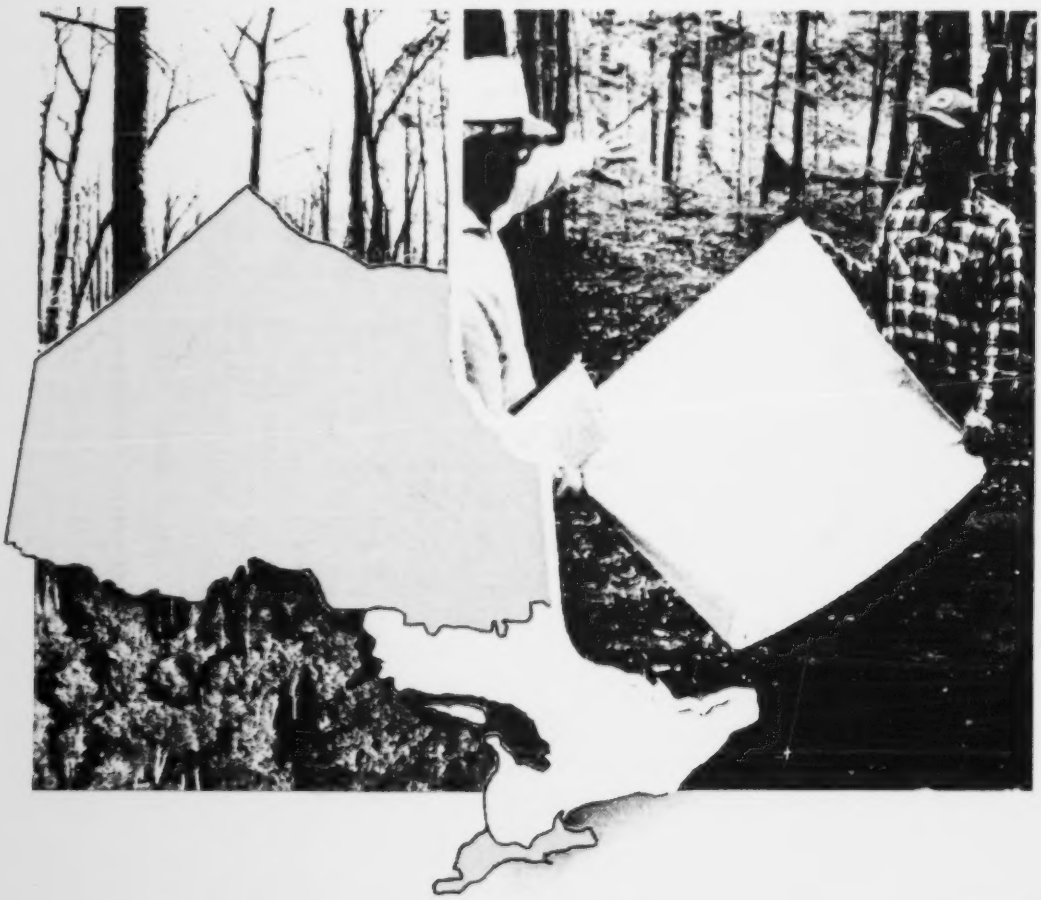
# Ontario Hardwood Silviculture Studies Database:

# Annotated Bibliography



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# Ontario Hardwood Silviculture Studies Database: Annotated Bibliography

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## Abstract

The Ontario Hardwood Silviculture Studies Database Version 1.0, which was released for user testing and feedback in 2003, was created using Microsoft Access 97. The database contains descriptive information, or *metadata*, from more than 90 ongoing and historical hardwood silviculture studies and trials in Ontario. Most of these studies were initiated by the Ontario Ministry of Natural Resources, the Canadian Forest Service, or forest industry in Ontario.

This report contains bibliographic citations and annotations (abstracts) for 314 publications, reports and other technology transfer products that are included in the publications section of the database. Citations in this report are sorted by author's last name and publication date, and include the type of publication (e.g., journal article, thesis, book, etc.) and the known location(s) of a hard copy. Author and subject indices are provided in appendices.

Within the database is an independent searchable publications section that provides citations and annotations (abstracts) of additional material, published or unpublished, that is related to studies in the database, or has resulted from other hardwood studies. Bibliographic citations were selected for inclusion in the database using the following criteria:

1. the study on which the citation was based occurred in Ontario;
2. the study included some type of silvicultural treatments and measurements of the resulting regeneration success or growth responses; and
3. the study focused on one or more of these hardwood tree species: sugar maple (*Acer saccharum* Marsh.), yellow birch (*Betula alleghaniensis* Britton), red oak (*Quercus rubra* L.), American beech (*Fagus grandifolia* Ehrh.), white ash (*Fraxinus americana* L.), black cherry (*Prunus serotina* Ehrh.), or basswood (*Tilia Americana* L.).

## Acknowledgements

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## Ontario Hardwood Silviculture Studies Database Project Overview

As a result of commitments made in the 1999 Ontario Forest Accord (OMNR 1999[1]), a comprehensive workshop was held to identify critical science and information gaps related to implementation of Intensive Forest Management (IFM). Several speakers and most breakout groups recommended that synthesis and effective communication of existing silvicultural knowledge were important elements of bridging these gaps (Bell et al. 2000[2]). The general lack of systematic long-term record keeping and retrieval systems of provincial and federal natural resource agency research units and the inevitable turnover of research staff are major factors contributing to information loss about existing or ongoing studies. Evaluation of archived information, if it were readily available, could contribute useful insights and data more quickly and cost effectively than new studies.

The Ontario Hardwood Silviculture Studies Database Project was launched in 2001 to gather descriptive information, or *metadata*, about hardwood silviculture studies in the province, and to organize and make that information readily available. More than 90 studies met our selection criteria for inclusion in the database; most of these were initiated by the Ontario Ministry of Natural Resources (OMNR), the Canadian Forest Service (CFS), or Ontario forest industry. The criteria were that the study:

1. occurred in Ontario;
2. included some type of silvicultural treatments and measurements of the resulting regeneration success or growth responses; and
3. focused on one or more of the following hardwood tree species: sugar maple (*Acer saccharum* Marsh.), yellow birch (*Betula alleghaniensis* Britton), red oak (*Quercus rubra* L.), American beech (*Fagus grandifolia* Ehrh.), white ash (*Fraxinus americana* L.), black cherry (*Prunus serotina* Ehrh.), or basswood (*Tilia americana* L.).

The metadata associated with these projects have a number of important uses, particularly when collected, organized, and presented in a single source such as a searchable relational database. First, the information can be used by researchers to identify and locate studies and datasets that may be of use to help answer specific science questions. A prior study may help to refine or direct a new study by providing supporting evidence or related results. As well, data and analyses from existing studies and/or published results may minimize the need for initiating a new study. The researcher may use data from a prior or ongoing study, either in its current form or through remeasurement or reanalysis, to address the science need. Similarly, research managers can use the metadata to help determine whether to fund a newly proposed study.

Second, the readily accessible metadata can help practitioners, i.e., field foresters, to quickly and efficiently determine if a regional study has been completed and reported on that provides useful applied information to a current forest management or silviculture science gap. Even if not designed to answer a specific current question for a given site or practice, the information from a former study that is made available in this way could provide at least some scientific foundation for a decision that cannot wait the years necessary for results from a new field study.

Third, current provincial and federal forest science resources are insufficient to fully maintain all of the active high quality hardwood silviculture studies in central Ontario. Using this database, OMNR and CFS science and

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1. Ontario Forest Accord Advisory Board. 1999. Ontario Forest Accord: A foundation for progress. Commitments by members of forest industry, the Partnership for Public Lands and the Ministry of Natural Resources, Toronto, ON. http://www.mnrgov.on.ca/MNR/olf/ofab/accord.html

2. Bell, F.W., D.G.Pitt, M. Irvine, W.C. Parker, L.J. Buse, N. Stocker, W.D. Towill, H. Chen, E. Pinto, K. Brown, D. DeYoe, T. McDonough, G. Smith, and M. Weber. 2000. Intensive forest management in Ontario: Summary of a 1999 science workshop. Ont. Min. Nat. Resour., Sault Ste. Marie, ON. Sci. Dev. & Transf. Sci. Rep. No. 003. 86 p.

management staff can more efficiently and effectively review, evaluate, prioritize, and schedule existing studies for future maintenance, treatment and measurement investments. Similarly, they can identify studies that do not meet certain minimum data or field criteria and terminate them.

The fourth significant application of the completed metadata database is to provide descriptive and spatial information on high-value hardwood silviculture studies in central Ontario to values-mapping and information-sharing efforts such as the Ontario Natural Resources Values Information System (NRVIS) and the federal Forest Ecosystem Research Network of Sites (FERNS). This will help to communicate the existence and values of these long-term research projects to a wider audience, and will help to protect such sites from inadvertent damage or loss due to resource or land use management decisions made without this knowledge.

In addition to the study metadata search and selection process described in the *Ontario Hardwood Silviculture Studies Database: Metadata Report* (Cole et al. 2003)[1], we performed an extensive literature search to locate any additional material, published or unpublished, that was related to studies in the database, or resulting from hardwood studies for which we have no metadata. Examples in include studies initiated by universities or private sector organizations, which were beyond the scope of the present study to locate and include. Literature was included only if the study from which it came met the criteria listed above. A total of 314 publications and products are included in the publications section of the database and in this report.

## Project Deliverables

The Ontario Hardwood Silviculture Studies Database Project resulted in four products. The first is the *Ontario Hardwood Silviculture Studies Database, Version 1.0*, including the publications section, which was developed and distributed in 2003 as a Microsoft Access 97 application.

The second product, *Ontario Hardwood Silviculture Studies Database: Metadata Report* (Forest Research Information Paper No. 152) is a printed document containing all available metadata fields for the studies included in the database as of March 2003.

The third product is this bibliography report, which is a printed version of the annotated bibliography included in the *Ontario Hardwood Silviculture Studies Database* as of March 2003.

The *Ontario Hardwood Silviculture Studies Database: User's Guide* is the fourth product from the project. It is provided only in electronic format as a companion to the Access 97 database.

## About the Annotated Bibliography

For each publication that met our inclusion criteria, we reviewed and, in many cases, revised the original annotations (abstracts) for clarity, brevity, or to avoid copyright infringement on material published outside of the provincial government. We also provided annotations for the small proportion of publications that had no original abstract. We have provided author (Appendix I), and subject keyword indices (Appendix II), which refer to the citation numbers in the report.

The publication type of each citation is shown below the annotation. The following categories were used:

- books and guides
- reports (information report, forest research note, tree planters note, newsletter, extension note, OMNR report, leaflet)
- journal papers
- theses
- proceedings (conferences, meetings, workshops)
- CD-ROMs
- video recordings

The last line of each citation is the organization to contact to request a copy or reprint of that title. For Ontario Forest Research Institute (OFRI) locations followed by an entry in parentheses ( ),

1. Cole, W.G., D.E. Lamntosh, and H.L. Todd. 2003. Ontario hardwood silviculture studies database: Metadata report. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 152.

please be sure to include the parenthetical information when contacting OFRI for a reprint. Contact information for the listed source libraries is provided in Appendix III.

## Contact Us

To submit comments, corrections, additions or questions about the Ontario Hardwood Silviculture Studies Database or any of its related products, or to request copies of any of the products described above, please contact us at the Ontario Forest Research Institute, 1235 Queen Street East, Sault Ste. Marie, ON, P6A 2E5, C/O Hardwood Ecosystem Research Scientist, or by email at information.ofri@mnr.gov.on.ca.

## Publications

1. Alemdag, I.S. 1984. Total tree and merchantable stem biomass equations for Ontario hardwoods. Can. For. Serv., Petawawa Nat. For. Inst., Petawawa, ON, Inf. Rep. PI-X-46. 54 pp.

   Aboveground biomass equations for single trees of 19 Ontario hardwood species were developed. These equations are for estimating biomass in terms of oven dry mass for the main components of trees, based on diameter at breast height and tree height and in terms of percent of the total stem mass for the merchantable and unmerchantable portions of the stem based on either breast height diameter and merchantable diameter or tree height and merchantable height. In addition, several other biomass relationships were established. Computer produced tables for preparing the data for analysis are included in this report, and an application of the prediction equations is demonstrated.

   Report

   OMNR Library

2. Anderson, H.W. 1960. Some observations on the quality of sugar maple in two second-growth tolerant hardwood stands of differing cutting history. Ont. Dept. Lands For., Res. Br., Maple, ON, File Rep. No. 122. 18 pp.

   Studies of the quality of sugar maple pole-size stems in 2 different cut-over stands indicate that quality is not directly associated with growth rate. The average growth rate was slow, however, due to suppression for varying lengths of time. Younger stems in uneven-aged stands tend to have fewer defects and suppressed trees may respond well to release through increased diameter growth. This increased diameter growth tends to improve the quality of these suppressed or defective trees. Frequent thinning is necessary to sustain quality growth, since defect becomes established in trees once their growth slows down, due to crown closure and resultant damage. Future work in this study could involve sampling trees showing a wider range of growth rate.

   Report

   Ontario Forest Research Institute

3. Anderson, H.W. 1964. Some notes on defect development in sapling and pole-sized sugar maple. Ont. Dept. Lands For., Res. Br., Maple, ON. 58 pp.

   This outline serves mainly as an introduction to and explanation of the philosophy of the research carried out on one aspect of the maple program. It has not been written as a justification for the program, nor is it intended to be presented for criticism of the analysis since it is as yet incomplete. Much of this project is being carried out co-operatively with the Forest Pathology Laboratory, Canada Department of Forestry, at Maple, Ontario.

   Report

   Ontario Forest Research Institute (SSI)

4. Anderson, H.W. 1973. Hardwood defects. Pp. 37-58 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., Div. For., For. Manage. Br., Toronto, ON. 84 pp.

   Illustrations and descriptions of various hardwood defects. This report provides some indication of relative merit when competing trees are being compared in

consideration of a future crop.

Report
Ontario Forest Research Institute (Cole)

5. Anderson, H.W. 1973. Some ecological aspects of quality control in trees and stands. Ont. Min. Nat. Resour., Div. For., Res. Br., Maple, ON, File Rep. 6-73. 46 pp.

This report comprises the text and illustrations originally presented at the Southern Region Timber Management Seminar on Tree Improvement and Silviculture Research, Feb. 23-24, 1972, in Barrie, Ontario. It deals with current research being conducted in south-central Ontario on defect control in sugar maple and regeneration of yellow birch. Also presented is *Fomes* root rot control in a red pine plantation in southern Ontario. Some ecological views on the concept of tree improvement are discussed.

Report
Ontario Forest Research Institute

6. Anderson, H.W. 1983. Individual tree growth and quality potential. Pp. 17-28 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., For. Manage. Br., Toronto, ON. 72 pp.

Discussion of how to assess present and potential vigour and quality of trees, based on crown characteristics, bark characteristics, stand characteristics, and risk.

Books and guides
OMNR Library

7. Anderson, H.W. 1983. Land features and their effects. Pp. 2-7 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., For. Manage. Br., Toronto, ON. 72 pp.

Description of land types in Algonquin Park, and the forests they best support.

Books and guides
OMNR Library

8. Anderson, H.W. 1983. Recruitment of hard maple. Pp. 50-52 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., For. Manage. Br., Toronto, ON. 72 pp.

Prescriptions for recruiting hard maple.

Books and guides
OMNR Library

9. Anderson, H.W. 1983. Regenerating yellow birch. Pp. 45-49 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., For. Manage. Br., Toronto, ON. 72 pp.

Information to be considered before initiating a silvicultural prescription to encourage yellow birch natural regeneration, as well as suggestions for the prescription and performance evaluation.

Books and guides
OMNR Library

10. Anderson, H.W. 1983. Regenerating yellow birch with prescribed fire (oral presentation). Pp. 168-172 *in* America's Hardwood Forests - Opportunities Unlimited: Proceedings of the 1982 Convention of the Society of American Foresters, Sept. 19-22, 1982, Cincinnati, OH. Soc. Am. For., Bethesda, MD., SAF Pub. 83-04.

Yellow birch can be successfully regenerated using suitable seedbed preparation techniques, including prescribed fire. Experimental fall burning of tolerant hardwood stands prior to harvesting under a group selection prescription resulted in a 90% reduction in hard maple advance growth stocking less than 1.5 m high. Subsequent yellow birch seedling stocking initially was as high as 250,000 stems/ha, decreasing to 4,000 stems greater than 2.5 cm DBH by age 15. Stocking was better on land areas disturbed by logging and where residual stocking densities exceeded 10 $m^2$/ha. Hard maple had not reoccupied the forest floor on burned sites 20 years after treatment.

Proceedings
OMNR Library

11. Anderson, H.W. 1983. Silvical characteristics influencing management options. Pp. 8-17 *in* Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., For. Manage. Br., Toronto, ON. 72 pp.

    Description of habitat, natural regeneration, establishment, and development of sugar maple, yellow birch, American beech, and eastern hemlock.

    Books and guides
    OMNR Library

12. Anderson, H.W. 1993. Learning to maintain biodiversity in tolerant hardwood forests. *In* The Role of Parks in Conserving Biodiversity: Proceedings of Provincial Parks Centennial Symposium, Sept. 1993, Dorset, ON. Ont. Min. Nat. Resour., Toronto, ON.

    An overview of research that has been conducted at the Swan Lake Forest Research Reserve in Algonquin Park is presented. Initially, scientists discovered successful methods for regenerating yellow birch, along with examining reproduction biology and ecology. Studies on the use of prescribed fire as a seedbed preparation technique were also investigated. A third study was established in 1960, which used prescribed fall fire and group selection (a form of patch cut) in a 2 ha area. An exclosure was designed to keep out wildlife. Results from the 3 different experiments are discussed.

    Proceedings
    Ontario Forest Research Institute (And.)

13. Anderson, H.W. 1994. Some implications of logging damage in the tolerant hardwood forests of Ontario. Pp. 3-28 *in* Rice, E.A., (ed.) Logging Damage: The Problems, and Practical Solutions. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON, For. Res. Inf. Pap. No. 117. 70 pp.

    Under the selection system of hardwood management, prescribed partial cutting repeatedly exposes the residual stand to the risk of logging damage. This guide considers some of the biological, ecological and management implications of logging damage, and discusses techniques to assess and avoid the damage.

    Report
    Ontario Forest Research Institute

14. Anderson, H.W. 1996. Sustainable forest management: case studies in tolerant hardwoods (oral presentation). *In* The Right Stuff for the Future: Proceedings of the Northeastern Forest Soils and the Great Lakes Forest and Soils Conference, July 7-9, 1996, Swan Lake Forest Research Reserve, Algonquin Provincial Park, ON. 87 pp.

    Field tour discussion of a mature tolerant hardwood forest site in Algonquin Provincial Park. Three treatments are discussed: natural forest (uncut), improvement cutting, and single-tree selection, along with the recommended stocking and harvest schedules.

    Proceedings
    OMNR Library

15. Anderson, H.W. 1996. Yellow birch: history, ecology, biodiversity, old-growth, and management (oral presentation). *In* The Right Stuff for the Future: Proceedings of the Northeastern Forest Soils and the Great Lakes Forest and Soils Conference, July 7-9, 1996, Swan Lake Forest Research Reserve, Algonquin Provincial Park, ON. 87 pp.

    Field tour discussion of 40 years of ecology and silviculture research on natural regeneration of yellow birch and stand development. The discussion includes sections on site attributes, birch autecology, silviculture prescriptions to encourage birch regeneration, and the use of prescribed fire.

    Proceedings
    OMNR Library

16. Anderson, H.W. 1998. Sustaining the tolerant hardwood forest with prescribed fire (oral presentation/abstract). *In* Fire Ecology: Proceedings of the Your Forest - Your Choice Conference Series, Part 3, Oct. 1-3, 1998, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

    Prescribed fire can be a useful tool to stimulate natural regeneration of some

tolerant species. Several prescribed burn experiments were done prior to 1960 to determine how to use fire safely and efficiently, as well as understanding its effects on the trees, forest floor, and soil. Following a brief analysis, researchers concluded that an applied silvicultural trial would be feasible. After the second burn in the fire physics series, 2.5 ac (1 ha) of the same stand was burned. A group selection improvement cut was then conducted to open the canopy and the area was fenced with a deer exclosure. After 1961, the survival of yellow birch decreased rapidly for the first 6 years. However, 22 years after the burn, yellow birch dominated the burned area and sugar maple dominated the unburned area. This was likely the result of an allelopathic effect of the birch on the maple. In both burned and unburned areas, the ideal basal area development of the birch occurred only at relatively low residual overwood basal areas associated with group openings. Even though it occupies unique niches, yellow birch can be regenerated and coexist with sugar maple and beech. Fire could be a useful tool for tolerant hardwood natural regeneration prescriptions.

Proceedings
Ontario Forest Research Institute
(And.)(SSI)

17. Anderson, H.W., Batchelor, B.D., Corbett, C.M., Deugo, D.T., Husk, C.E., Wilson, W.R. 1990. A Silvicultural Guide for the Tolerant Hardwood Working Group in Ontario. Ont. Min. Nat. Resour., Toronto, ON. Sci. Technol. Ser. Vol. 7. 178 pp.

This guide has been prepared to assist in the planning, execution, and evaluation of silvicultural techniques appropriate to the tolerant hardwoods working group on Crown lands in Ontario, but could also be used effectively for similar forest conditions in other jurisdictions. The information presented is designed to allow the forest manager to efficiently manage forest lands through harvesting, regenerating, and tending, while maintaining other forest and environmental values. This guide is a revision and update of a similar OMNR guide produced by Bruce and Heeney (1974), and augments the manual *Management of Tolerant Hardwoods in Algonquin Provincial Park*. It is intended to be used with *A Tree Marking Guide for the Tolerant Hardwoods Working Group in Ontario*.

Books and guides
OMNR Library

18. Anderson, H.W., Boysen, E.P., Dey, D.C., Rice, J.A. 2001. Natural regeneration of hardwoods. Pp. 393-421 *in* Wagner, R.G., Colombo, S.J. (eds.) Regenerating the Canadian Forest: Principles and Practice for Ontario. Fitzhenry and Whiteside, Ltd., Markham, ON. 650 pp.

There is great diversity of hardwood forest ecosystems across Ontario. When facilitating natural regeneration, forest managers should have a good comprehension of a species' biological and ecological characteristics. The silvical diversity is summarized in 2 tables for the 21 species covered in this chapter. Five case studies illustrate how silvicultural systems can be matched to the ecological requirements of various species. Methods for regenerating yellow birch, red oak, trembling aspen, and basswood are outlined.

Books and guides
OMNR Library

19. Anderson, H.W., McLean, M.M. 1960. Effects of animal damage on forest tree regeneration: a discussion presented to the Third Annual Sportsmen's Conservation Workshop at Swan Lake, September 11, 1960. Ont. Dept. Lands For., Res. Br., Maple, ON. Unpubl. Rep., 9 pp.

The focus of this discussion is to provide delegates of the workshop with knowledge of some of the forestry problems related to wildlife activities. Tree seedlings depend on moisture and temperature to grow properly. They must compete against other

species for light and growing space. When animals are browsing, the most vigorous seedlings are usually selected. It may be that these seedlings are more available to the animals, or that they taste better. Browsing issues are addressed for the following species: hare, deer, mice, voles, beaver, porcupine, and bears.

Report
Ontario Forest Research Institute

20. Anderson, H.W., McLean, M.M. 1970. Value-increase potential of various grades of sugar maple trees. Ont. Dept. Lands For., Res. Br., Maple, ON. Unpubl. Rep. 19 pp.

A lumber recovery study was conducted following a silvicultural stand improvement cut in a tolerant hardwood stand in Algonquin Park in 1968. This file report uses the lumber-recovery data to simulate the potential value-increase of residual trees resulting from improved growing conditions. Stem diameter (DBH) measurements were taken and a 5-category tree classification system was used to assess the ability of individual trees to increase in value following release. Logs (n=200) were harvested, labelled, scaled, and graded. Volume of each grade, log, and tree was calculated. Tree value was plotted over DBH for each volume class and freehand curves were drawn for each class. Researchers then calculated interest rates, compounded annually, for value-increase in each volume class by DBH for hypothetical DBH growth rates of 1, 2, 3, or 4 inches over 10- and 20-year periods.

Report
OMNR Library

21. Anderson, H.W., Racz, J.C. 1990. Some preliminary results from silvicultural research in tolerant hardwoods in the Algonquin Region. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. Unpubl. Rep. 40 pp.

This file report summarizes some recent results of silvicultural studies in tolerant hardwood stands initiated by M.M. McLean, formerly research forester with the Ontario Forest Research Institute (OFRI) field unit in the Algonquin region. The report is a preliminary overview only, intended to provide an update of the status and some general interpretations of the studies. More detailed individual scientific reports will be published as the data analyses are completed.

Report
Ontario Forest Research Institute (Cole)

22. Anderson, H.W., Rice, J.A. 1989. Modelling tolerant hardwood stand dynamics to improve silvicultural prescriptions (Abstract/Poster No 132). P. 104 *in* Forestry Research Marketplace: Results in Action, Nov. 21-23, 1989, Toronto, ON. OFRC Symp. Proc. O-P-18. 151 pp.

Some effects of experimental management strategies on the temporal changes in regeneration development, stand structure, tree growth and quality in tolerant hardwood stands in south-central Ontario are illustrated by means of graphic and regression analysis. An interactive computer model demonstrates stand dynamics resulting from harvesting and silvicultural treatments.

Proceedings
OMNR Library

23. Anderson, H.W., Rice, J.A. 1990. Swan Lake Forest Research Reserve, Algonquin Provincial Park: general tour guide. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. Unpubl. Rep. 35 pp.

This tour guide describes the Swan Lake Forest Research Reserve and its history, and discusses some of the current silvicultural research being undertaken on the reserve. The studies and sites discussed are: natural uncut forest, cutting for stand improvement, prescribed fire physics, yellow birch stand dynamics, selective cutting, uncontrolled cutting, and an experimental spruce plantation. (Also reprinted as Anderson, H.W., Rice, J.A. 1994. Swan Lake Forest Research Reserve, Algonquin Provincial Park: general tour guide. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 35 pp.)

Report
Ontario Forest Research Institute

24. Anderson, H.W., Rice, J.A. 1993. A tree marking guide for the tolerant hardwoods working group in Ontario. Ont. Min. Nat. Resour., Toronto, ON. Sci. Technol. Ser. Vol. 8. 227 pp.

    This guide augments *A silvicultural guide for the tolerant hardwoods working group in Ontario*. It is intended for use at the stand level, where marking prescriptions are normally determined by both tree and stand characteristics in relation to timber, wildlife and other ecosystem management objectives.

    Books and guides
    OMNR Library

25. Anderson, H.W., Rice, J.A. 1996. Quality assurance in hardwood tree marking: a case study. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Rep. No. 141. 14 pp.

    An intensive audit was implemented by the Ontario Ministry of Natural Resources in Algonquin Provincial Park in 1986 to monitor the quality of tree marking operations. A total of 295 0.1-ac (0.04 ha) plots were established in 87 tolerant hardwood stands marked under the selection system. Results indicate that a maximum allowable error of 10%, expressed as relative number of tree-choice and/or basal area errors, is a realistic quality standard. The need for continuous monitoring to track performance and to allow revision of these standards is discussed. Suggestions for efficient sampling design and data collection methods are outlined.

    Report
    Ontario Forest Research Institute

26. Anderson, H.W., Rice, J.A., Roberts, K.W., Beekers, W. 1987. Maintaining a yellow birch component using group selection (poster presentation). P. 423 *in* Nyland, R.D. (Ed.) Managing Northern Hardwoods: Proceedings of a Silvicultural Symposium, June 23-25, 1986, Syracuse, NY. SUNY ESF Facul. For. Misc. Publ. No. 13 (ESF 87-002). Soc. Am. For. Publ. No. 87-03. 430 pp.

    Released advance growth sugar maple seedlings usually replace yellow birch trees. The usual way to tend birch is to prepare the seedbed using prescribed fire, then conduct group selection to extend the canopy reduction. To obtain optimum growth rate and stem quality, stocking levels and peer competition should be modified. Ideal conditions for growing yellow birch require having overhead light, modest site competition, along with maintaining even-aged patches within uneven-aged sugar maple.

    Proceedings
    Ontario Forest Research Institute

27. Anderson, H.W., Roberts, K.W., Rice, J.A., Beekers, W. 1985. Ecology and silviculture of tolerant hardwoods (poster presentation). *In* Proc. Can. Ont. Joint For. Res. Comm. Symp., Geneva Park, ON.

    Two poster presentations related to sugar maple and yellow birch in single-tree and group selection are available. The first presentation discusses defects in sugar maple resulting from stem wounds. Growth rate can be estimated using growth models that relate vigor to crown size and position and point density or competition. When tree selections are being conducted, an overall stand stocking/structure model should be used to ensure that there will be a supply of harvestable material. The second presentation focuses on maintaining a yellow birch component while using group selection. Seedbed preparation used with prescribed fire, along with group selection, usually results in good yellow birch stocking. After preparation of the seedbed, the growth rate and stem quality that continue are related to the residual stocking and peer competition. Ideal conditions for yellow birch occur when there is overhead light and modest side competition; this typically involves even-aged patches of yellow birch within uneven-aged sugar maple.

    Proceedings
    Ontario Forest Research Institute (SSI)

28. Anderson, H.W., Smith, G.D. 1972. Twenty-two-year development of spruce and pine interplanted in a heavily cut hardwood forest in south-central Ontario. Ont. Min. Nat. Resour., Div. For., Res. Br., Maple, ON. File Rep. No. 3. 20 pp.

    An attempted conversion of heavily cut-over tolerant hardwood forest to conifer or mixedwood failed primarily because the site was best suited for the native hardwood. The cleared areas were quickly recaptured by the sugar maple understorey, entirely to the disadvantage of the planted stock.

    Report
    Ontario Forest Research Institute

29. Anonymous. 1985. Planting northern red oak: a prescription. Pp. 1-11 *in* Proceedings of a workshop, Sept. 11, 1985, Bracebridge, ON.

    A 4-step prescription for planting northern red oak on forested sites with a mature overstorey is presented. This prescription was originally designed for the Missouri Ozarks; however, the principles also apply to northern Ontario. Reasons for planting red oak include: (1) to supplement the natural regeneration potential of red oak; (2) to introduce northern red oak where it is absent, and (3) to introduce specific genotypes as part of a tree improvement program. The main focus of this prescription is to provide enough planted trees to obtain adequate stand stocking, while minimizing disturbance to the existing plant community and site, the number of trees planted, and cost. Economic, ecological and physiological constraints or considerations should be examined while conducting the prescription. The 4-step prescription includes the following steps: (1) control competition with a herbicide before planting; (2) create a medium-density shelterwood; (3) underplant large-diameter nursery stock, and (4) remove the shelterwood 3 growing seasons after planting. Costs for using this prescription depend on how many trees per acre are planted. A discussion is provided explaining why the prescription works.

    Proceedings
    Ontario Forest Research Institute (SSI)

30. Anonymous. 1986. Tour: Swan Lake Forest Research Reserve, OTIFBI scientific review. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. Unpubl. Rep.40 pp.

    This unpublished report provides information on various studies done at the Swan Lake Forest Research Reserve. A history of the research that occurred on the reserve since the 1950s is provided. Experiments were conducted in 1953 with yellow birch that involved summer logging, a range of skidding operations, and the creation of gaps and variable size patches. This research lead to the expansion of the program in 1957 and projects on the growth and quality of sugar maple, prescribed fire for seedbed preparation, and studies of the genetics and the volume growth of the genus *Picea*. Maps and an air photo illustrated the stands and the area of the reserve. In this tour guide, 3 stops are used to describe tolerant hardwood natural regeneration dynamics, selection cutting trials, and *Picea* research in further detail. Stop 1 describes a 1960 experimental cutting and partial prescribed burn for yellow birch. The area was marked for a partial cut, then scarified, thus creating residual stocking levels. The entire block was fenced to exclude deer. After 20 years, yellow birch regeneration density was influenced by the original seedbed condition. Growth performance appeared to be influenced by the original overhead canopy density. Original residual basal area was positively correlated with survival and negatively correlated with height growth and diameter growth. Even 20 years after the burn, maple did not regenerate, possibly due to allelopathic influences of the birch. The maple responded well to release by partial cutting when there was no birch component. Stem quality was influenced by intraspecific competition. For high-quality volume production, crop tree selection and effective crop-tree crown release are recommended. Yellow birch can be

maintained using group selection silviculture.

Report
Ontario Forest Research Institute (SSI)

31. Anonymous. 1995. Red Oak. Landowner Res. Cent./Sir Sanford Fleming Coll./Ont. Min. Nat. Resour., Toronto, ON. Ext. Note LRC 13. 4 pp.

Information is provided on how to identify and grow red oak trees, the uses of red oak, and various methods for managing red oak for wood and wildlife habitat. Diseases and invasive species are covered along with environmental, biological, and management stresses.

Report
Ontario Forest Research Institute (SSI)

32. Anonymous. 1995. Tree shelters help hardwood trees grow faster. Landowner Res. Cent./ Ont. Min. Nat. Resour., Toronto, ON. Ext. Note LRC 1. 4 pp.

Tree shelters improve the growth and survival of hardwood tree seedlings by protecting them from animal browsing and temperature extremes. They are useful for reestablishing hardwood forests on abandoned agricultural land and other areas. This fact sheet provides information about the types of tree shelters that are available and how to use them effectively.

Report
Ontario Forest Research Institute (SSI)

33. Ardenne, M. 1948. Southern hardwood volume tables project: progress report. Ont. Dept. Lands For., Res. Div., Maple, ON. Unpubl. Rep. 5 pp.

This progress report includes a record of the season's work, general results, costs to date and proposals for next season's work.

Report
Ontario Forest Research Institute

34. Ardenne, M. 1950. Southern hardwood volume tables project: progress report. Ont. Dept. Lands For., Res. Div., Maple, ON. Unpubl. Rep. 6 pp.

Volume tables for the main hardwood species in southern Ontario are presented in this progress report.

Report
Ontario Forest Research Institute

35. Ardenne, M. 1950. Southern hardwood volume tables: temporary report. Ont. Dept. Lands For., Res. Div., Maple, ON. Unpubl. Rep. 11 pp.

Detailed measurement of sugar maple and yellow birch trees including merchantable lengths.

Report
Ontario Forest Research Institute

36. Ardenne, M., Hughes, E.L., Morrison, L.M. 1951. Volume tables for southern Ontario hardwoods. Ont. Dept. Lands For., Res. Div., Maple, ON. Res. Rep. No. 22. 60 pp.

Volume tables for the merchantable hardwood species in southern Ontario were constructed using the harmonized curves method.

Report
OMNR Library

37. Balatinecz, J.J., Anderson, H.W. 1989. Effects of climatic factors on the formation of wood and its quality. *In* MacIver, D.C.; Street, R.B., Auclair, A.N. (eds.) Climate Applications in Forest Renewal and Forest Production: Proceedings of Forest Climate '86, Nov. 17-20, 1986, Geneva Park, Orillia, ON. Ont. Min. Nat. Resour. 307 pp.

Wood quality between and within trees of a species varies in response to 3 principal factors: (1) changes in the vascular cambium with age; (2) genetic potential within a tree; and (3) environmental influences on growth. Climatic factors of the environment influence wood formation both directly and indirectly. Results of laboratory experiments and field observations are presented on the effects of photoperiod, drought, and temperatures on wood formation in larch and hybrid poplar as typical examples.

Proceedings
OMNR Library

38. Bankowski, J., Dey, D.C., Boysen, E.P., Woods, M.E., Rice, J.A. 1996. Validation of NE-TWIGS for tolerant hardwood stands in Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For Res. Inf. Pap. No. 130. 21 pp.

    This paper reports tests of NE-TWIGS, an individual-tree, distance-independent stand growth simulator, for Ontario's tolerant hardwood stands. It indicates that although stand productivity data may improve its performance, NE-TWIGS does not reliably predict basal area, particularly for medium and large sawlogs, in Ontario's hardwood stands.

    Report
    Ontario Forest Research Institute

39. Bankowski, J., Dey, D.C., Woods, M.E., Rice, J.A., Boysen, E.P., Miller, R.J. 1995. Validation of SILVAH for tolerant hardwoods in Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 128. 28 pp.

    SILVAH, a stand growth simulator commonly used in the northeastern United States, was evaluated by comparing predicted and actual growth of tolerant hardwoods in 139 managed and unmanaged stands in southern Ontario. The data were used to test the accuracy of diameter distribution, basal area, mean quadratic DBH, number of trees per hectare, and stand volume predictions for periods from 5 to 20 years. The performance of the model was poor due to: (1) lack of ingrowth data or lack of an automatic ingrowth submodel, (2) incompatibility of model requirements and data sets related to the range of tree sizes in the input list, and (3) inability of the model to account for differences in site productivity.

    Report
    Ontario Forest Research Institute

40. Bankowski, J., Dey, D.C., Woods, M.E., Rice, J.A., Boysen, E.P., Batchelor, B.D., Miller, R.J. 1995. Validation of FIBER 3.0 for tolerant hardwood stands in Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 124. 32 pp.

    The reliability and limits of growth simulator FIBER 3.0 has been tested using data from long-term studies of hardwood stands in Ontario. Five-year growth projections are reliable, but the model's long-term performance is less satisfactory. Individual stand projections can vary considerably, and are affected by species composition and the size of sample plots. FIBER is more accurate in uneven-aged than in even-aged stands.

    Report
    Ontario Forest Research Institute

41. Basham, J.T., Anderson, H.W. 1977. Defect development in second-growth sugar maple in Ontario. I. Microfloral infection relationships associated with dead branches. Can. J. Bot. 55: 934-976.

    From 293 second-growth sugar maple trees felled in Ontario, 966 branch stubs, 70 intact dead branches, and 58 stem stubs were dissected and studied. Microfloral associations, examined and related to many tree and wound characteristics with computer assistance, show a progressive pattern of fungi invasion, spread, colonization, and replacement within dead branches, stubs, and adjacent stem wood tissue. This paper documents the process and identifies the various organisms.

    Journal paper
    OMNR Library

42. Beckwith, A.E. 1973. Hardwood program of the mensuration unit, Forest Research Branch, Ontario Ministry of Natural Resources. Pp. 53-57 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

    Hardwood management data collection for various projects is most productive when cooperation is achieved among sponsoring agencies. New methods of measuring growth, branch size, defects, etc. of standing trees need to be developed and

agree upon to ensure consistent data collection.

Proceedings
OMNR Library

43. Bellhouse, T., Naylor, B.J. 1993. A model for the estimation of canopy closure from basal area in the tolerant hardwood working group. Ont. Min. Nat. Resour., Central Ont. Sci.
Technol. Devel. Unit, North Bay, ON. Tech. Rep. No. 21. 19 pp.

Forest management guidelines may constrain timber harvest to ensure that minimum canopy closure requirements are met for specific wildlife species such as the red-shouldered hawk. A model has been developed to relate canopy closure to basal area in the tolerant hardwood working group (hard maple, beech, yellow birch) and stands characterized by a mixture of tolerant and mid-tolerant hardwoods (e.g., basswood). The model provides a conservative estimate of canopy closure from the basal area of a stand, and therefore provides a means of estimating residual canopy closure. Various polewood and small, medium and large sawlog combinations, all yielding 70% canopy closure, are presented graphically.

Report
OMNR Library

44. Bentley, C.V., Pinto, F. 1994. The autecology of selected understorey vegetation in central Ontario. Ont. Min. Nat. Resour., Cent. Reg. Sci. Technol. Devel. Unit, North Bay, ON. Tech. Rep. No. 31. VMAP Tech. Rep #93-08. 167 pp.

This manual is a summary of autecological information on plant species that grow in the forest understorey and compete with commercially important crop trees in central Ontario. Included are 37 shrub and 1 fern species. The material is organized for quick reference and is relevant to integrated forest management and developing vegetation management alternatives. For each plant species, a description is given of general characteristics, leaves, flowers, fruiting structure, roots, and notes on similar species, with a line drawing of features helpful for plant recognition. Each summary also includes information from a literature review on habitat requirements (range and microclimate), growth and development (above and below ground), phenology and natural regeneration, responses to silvicultural treatments and disturbances (overstorey removal or partial removal, fire, mechanical site preparation, cutting, mulches, herbicides, fertilization, and grazing), competitive effects on selected tree species, use as wildlife habitat, ecological significance, and cultural value.

Report
OMNR Library

45. Berry, A.B. 1963. Developing an ideal growing stock for tolerant hardwoods in central Ontario. For. Chron. 39(4): 467-476.

This study took place on a 47-ac (19 ha) woodlot at the Petawawa Forest Experiment Station, in Renfrew County, Ontario. The focus of the study is to determine the stocking and stem distribution that provides maximum growth of hardwoods, designated as optimum growing stock. Once the stocking and stem distribution have been determined, a financial optimum can be calculated for various economic conditions. Species composition in the upper and middle canopy levels of this forest stand consists of mixtures of tolerant hardwoods. Prior to 1904, the woodlot was high-graded for the best timber, grazed by cattle, and harvested for fuelwood. Between 1936 and 1956, an effort was made to manage the woodlot so that it would have a more balanced stand structure, while achieving maximum wood volume growth. Four balanced stem-number distributions were tested to examine the 2 levels of growing stock and 2 upper diameter limits, combined with 2 cutting cycles. This analysis was designed from the available data for the cover type and site. A diagram illustrates curves that were drawn based on these distributions. The statistical analysis concludes what the optimum stand structure is for the woodlot.

Journal paper
OMNR Library

46. Berry, A.B. 1981. A study in single-tree selection for tolerant hardwoods. Can. Dept. Env., Can. For. Serv., Petawawa Nat. For. Inst., Petawawa, ON. Inf. Rep. PI-X-8. 11 pp.

Interim results are presented for a large-scale experiment in managing tolerant hardwoods by single-tree selection at the Petawawa National Forestry Institute. The aim of the experiment is to evaluate growth response at 2 upper diameter limits (40 and 50 cm), 2 levels of growing stock (140 and 210 $m^3$/ha), and 2 cutting cycles (5 and 10 years). Residual volume and upper diameter limit significantly affected mortality rate and net volume growth, but length of cutting cycle did not. Natural regeneration, especially that of sugar maple, was satisfactory under all treatment combinations.

Report
Petawawa Research Forest

47. Berry, A.B. 1981. Metric form class volume tables. Can. Dept. Env., Can. For. Serv., Petawawa Nat. For. Inst., Petawawa, ON. Inf. Rep. PI-X-10. 24 pp.

Form-class volume tables are important tools in computing tree volumes of permanent and temporary sample plots. It was necessary to convert the tables from original units to metric equivalents when Canada adopted the metric system. Suitable regression equations were also developed from the original tables so they could be quickly computed. This report describes how these regression equations were entered and developed using a PDP 11 computer. Researchers compared the original tabular and calculated values and found volume differences to be less than 1.0 $ft^3$ (0.028 $m^3$)for any species. The exception was with the basswood, where the difference was 1.2 ft3 (0.034 $m^3$), or approximately 2% of the tabular value. A difference of up to 75% existed in small diameter classes. Values derived for the median height class shown in the table were no greater than 1% of the tabular value for any given diameter class. For both the 2-cm diameter and 2-m height classes, regressions were solved. Form-class values were interpolated or projected from 2 adjacent form-class equations or tables.

Report
OMNR Library

48. Bonser, S.P., Aarssen, L.W. 1994. Plastic allometry in young sugar maple (*Acer saccharum*): adaptive responses to light availability. Am. J. Bot. 81(4): 400-406.

Two study sites were used for this project, one near Cannisbay Lake in Algonquin Park and one at the Queen's University Biological Station in South Crosby Township, Ontario. The study examined age, height, number of shoot endings, neighbour density, and overhead cover from local neighbours for over 1400 young sugar maple trees under 200 cm tall in open versus closed habitats. Sugar maple trees of open habitats had increased branching relative to height growth, which contrasted with closed habitats where branching was delayed. A delay in branching also occurred in habitats where dense cover existed. Closed habitats had the oldest and tallest unbranched seedlings, while the youngest seedlings showing first branches occurred in open habitats. When there is greater light available to trees, there is an increase in branching. When there is a decrease in light availability, there is an increase in vertical growth.

Journal paper
OMNR Library

49. Boycott, S.L. 1983. Preliminary analysis of the site preparation project in the north central region. Lakehead Univ., School of Forestry, Thunder Bay, ON. B.Sc.F. Thesis. 49 pp.

An assessment of a 2-year site preparation project was conducted from 1980 to 1982 across the North Central Region of Ontario. The main purpose of the study was to define the limits of equipment. This study involved 42 assessment areas with 660 plots; 10 equipment combinations were sampled. Nine 2-row Bracke assessment areas were visited providing a total of 135 sample plots. The data were summarized and analyzed, and 2

equations were derived — one each for net mineral soil exposure and gross mineral soil exposure. Factors found to influence the amount of net mineral soil exposed by the Bracke included operator efficiency, rock content, soil depth, the number of scalps per hectare, and the number of stems per hectare of competition. The amount of gross mineral soil exposed was influenced by operator efficiency, soil texture, slash depth, soil depth, and the number of scalps per hectare. Other equipment combinations and their influences on site are presently being studied in the North Central Region.

Thesis
Lakehead Univ. Library

50. Bruce, D.S., Heeney, C.J. 1977. A silvicultural guide to the hard maple, yellow birch and hemlock working group in Ontario., Ont. Min. Nat. Resour. Maple, ON. 50 pp.

This report deals with the silvical characteristics and guides to treatment for the tolerant hardwood working group in the Great Lakes-St. Lawrence and deciduous forest regions. Hard maple, yellow birch and hemlock are the main species in this working group. However, many minor species are also encountered over its range and it can be a very heterogeneous forest. The species in the group exhibit a range of tolerance from the tolerant hard maple, beech, and hemlock to the intolerant white birch, and poplar. In the most southwesterly part of the province, the working group is modified by the presence of Carolinian species such as walnut, butternut, tulip, hickory and cottonwood. These prescriptions are based on the published literature of the silvics of these species, on reports of cultural treatments, experiments and management of the working group, and on the experience of staff members.

Report
OMNR Library

51. Burton, D.H. 1951. Study of yellow birch. Pp. 64-68 *in* Ont. Dept. Lands For., Res. Div., Maple, ON. Ann. Prog. Rep.

During the summer of 1950, the research office of the South Central Region of Ontario undertook a long-term study of yellow birch because of the unsatisfactory natural regeneration of the species in cut and uncut stands. Burton describes the establishment components of the study.

Report
Ontario Forest Research Institute

52. Burton, D.H. 1958. Reports and publications of forest research. Ont. Dept. Lands For., Res. Div., Maple, ON. For. Sect. Rep. No. 20. 24 pp.

This publication lists the reports of the forest research sections of the Division of Research, Department of Lands and Forests from 1930 to 1934, and from 1944 to 1958. In addition, early surveys of a research and semi-research nature are included.

Report
OMNR Library

53. Burton, D.H. 1968. Silviculture and management of maple. Ont. Dept. Lands For., Res. Div., Maple, ON. File Rep. 4 pp.

The author comments on a paper on natural regeneration by Carl H. Tubbs, Silviculturalist, North Central Forest Experiment Station. The application of classical cutting systems (clearcutting, shelterwood and selection system) and the varying degrees of success with maple regeneration are discussed.

Report
Ontario Forest Research Institute

54. Burton, D.H., Anderson, H.W., Riley, L.F. 1969 Natural regeneration of yellow birch in Canada. Pp. 55-73 *in* Proc. Birch symposium, Aug. 19-21, 1969, Univ. New Hampshire, Durham, NH. USDA For. Serv., Northeast For. Exp. Stn., Upper Darby, PA. 183 pp.

Yellow birch (part of approximately 7% of the total hardwood growing stock) occurs throughout much of north-central and eastern Ontario. In 1965, yellow birch occurred in 19% of the total hardwood cut from crown lands. It accounted for 50% of the stumpage value for that year. Regeneration surveys from 1931 to 1968

concluded that a serious lack of young growing stock in Ontario stands existed. To address this problem, improved regeneration methods and management techniques designed to reduce pressure on the remaining trees were being implemented. Background research into various studies concerning birch seed germination, along with experimentation with different regeneration systems is discussed. These experiments occurred in Algonquin Park, Haliburton, and Algoma. A summary of the impacts of prescribed burning on seedbeds is provided and the report describes the effects of light conditions on yellow birch growth.

Proceedings
OMNR Library

55. Burton, D.H., Sloane, N.H. 1958. Progress report on prescribed burning in the hard maple-yellow birch cover type in Ontario. Ont. Dept. Lands For., Res. Div., Maple, ON. Sect. Rep. No. 25. 10 pp.

The experiment described in this report is directed towards improving low-quality hardwood stands through prescribed burning. Preparing the seed bed for spruce, pine and yellow birch seed and partially eliminating brush competition are the desired results.

Report
OMNR Library

56. Cameron, D.A. *Undated.* Biomass production from the harvesting of a tolerant hardwood stand in Algoma, Ontario. Can. For. Serv., Sault Ste. Marie Energy From Forest Programme, Sault Ste. Marie, ON. 27 pp.

Five types of integrated sawlog/chipping harvesting operation were carried out in an overmature sugar maple-yellow birch stand. Treatments included clearcutting to 2 diameter limits, shelterwood to a diameter limit, shelterwood with slash chipping, and slash chipping of a previously harvested strip. Prices for chips did not justify an integrated harvesting programme.

Report
Ontario Forest Research Institute (And.)

57. Canadian Forest Service. 1973. Management of southwestern Ontario hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

The hardwood forests of southwestern Ontario possess many features that together make them unique in Canada. They are fragmented into innumerable woodlots, nearly all of which are privately owned; they contain valuable species such as black walnut, black cherry and white ash, some of which are near the northern limit of their ranges; they occupy land that is often nearly the best in Canada for either agricultural or forestry use; and they are easily accessible to densely populated areas. Thus there are heavy demands on the forests for the production of hardwood lumber and veneer, the production and protection of wildlife, the provision of recreational facilities, and even the provision of more agricultural land. Yet their fragmented nature and pattern of ownership impose severe constraints on their active management for any but the latter purpose. There are also large areas of land that were cleared for agriculture and now are abandoned. On such areas reforestation is difficult and expensive, especially where hardwoods are the preferred species. The objective of this symposium was to bring together forest managers and researchers to present and exchange their views on the technical and social problems of managing the hardwood forests, to define present problems, and to provide a comprehensive background for future research.

Proceedings
OMNR Library

58. Canadian Forest Service. 1993. Forest insect and disease conditions in Ontario: survey bulletin, spring 1993. Nat. Resour. Can., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. 4 pp.

Three Northern Ontario Development Agreement (NODA) projects were

undertaken by the FIDS (Forest Insect and Disease) Unit in 1992 to develop a spruce budworm hazard rating system for northern Ontario forests. Various sugar maple and red oak studies across Ontario are discussed relating to the problems of pests and crown conditions. Two Acid Rain National Early Warning System (ARNEWS) plots were established in the Central Region, one each in white birch and red oak stands.

Report
OMNR Library

59. Canadian Forest Service. 1994. Forest insect and disease conditions in Ontario: survey bulletin, spring 1994. Nat. Resour. Can., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. 1 p.

This short bulletin describes an oak leaf shredder study established in 1977 on approximately 13 100-tree-plots in red oak stands in Ontario. The experiments were originally used to evaluate the effects of oak leaf shredder infestations. A long-term study on this insect was underway in 1994. An improvement in the health of the stands was transpiring in 1993.

Report
OMNR Library

60. Carlson, W.C. *Undated.* Root initiation induced by root pruning in northern red oak. Unpubl. Rep. 3 pp.

Planting hardwoods can be justified: (1) to control the genetic characteristics of the trees in the new stand; (2) to modify the species composition of the new stand; (3) to maintain a preplanned stocking density (trees/ha), and (4) to prepare for possible future intensification of hardwood silviculture. Artificial regeneration methods and problems are discussed. Nursery lifting and root pruning are recommended to obtain a short root system for field planting. This paper also covers the methods and results from a program started in 1970 to study the nature of biochemical stimuli involved in lateral root initiation following root pruning in northern red oak. A key factor affecting root initiation in red oak may be that the natural source of cytokinins is removed. This decreases the concentration of cytokinins in the root while increasing the IAA level; however, additional research is necessary to confirm this.

Report
Ontario Forest Research Institute (SSI)

61. Cole, W.G. 1995. Hardwood tree crown measurement guide. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 18 pp.

The objectives of this guide are: (1) to document the methods used to collect hardwood tree crown data in 1993 on a subset of the OMNR Growth and Yield Program permanent sample plots in central and southern Ontario (data sets are on file at OFRI and at the OMNR Science and Technology Unit offices in North Bay and Kemptville); (2) to provide a set of standardized crown size measurement protocols for use in crown-based hardwood research and development projects in Ontario; and (3) to be a training guide and field reference manual for tree crown data collection. The methods presented in this guide are based on previous hardwood crown dynamics and modeling research in the Lake States. Initial plot measurements were made on medium-to-high productivity hardwood sites in the central and southern regions of Ontario, where production of high-quality hardwood lumber and veneer is an important forest management objective. Tree species sampled were sugar maple and northern red oak.

Report
Ontario Forest Research Institute

62. Cole, W.G., Gillis, T., Ripmeester, W. 1998. Swan Lake Forest Research Reserve geographic information system user's guide. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 140. 26 pp.

This report summarizes a custom GIS application developed in ArcView v3.0a for use on 486 or Pentium-based personal computers. It is the first comprehensive effort to compile and digitize spatial data

from nearly 50 years of research and extension activities. The report includes minimum system requirements, installation instructions, and an overview of the main application features.

Report
Ontario Forest Research Institute

63. Cole, W.G., Gillis, T., Ripmeester, W. 1998. Swan Lake Forest Research Reserve geographic information system. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. CD-ROM.

This is a custom GIS application developed in ArcView v3.0a for use on 486 or Pentium-based personal computers. It is the first comprehensive effort to compile and digitize spatial data from nearly 50 years of research and extension activities. Using custom-programmed buttons and pull-down menus, users can display, manipulate, and print data layers from the Ontario Base Map (OBM) system, Forest Resource Inventory (FRI), and Surficial Geology of Ontario database, as well as information about study locations and plot layouts, study metadata, and reserve building and utilities information. The software is distributed on one compact disc. The ArcView software necessary to run the application is not included.

CD-ROM
Ontario Forest Research Institute

64. Cole, W.G., Mallory, E.C., Niblett, D.N. 1999. Swan Lake Forest Research Reserve annotated bibliography 1955-1999. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 144. 57 pp.

This annotated bibliography contains references and abstracts for more than 250 papers, reports, and other technology transfer products that were produced, in whole or in part, as a result of research that has occurred at the Swan Lake Forest Research Reserve. The citations are divided into 2 categories: publications (160) and other technology transfer products (92). New contributions will be compiled and added to future revisions or addenda to this bibliography.

Report
Ontario Forest Research Institute

65. Coons, C.F. 1987. Sugar bush management for maple syrup producers. Ont. Min. Nat. Resour., Maple, ON. Unpubl. Rep. 48 pp.

This guide discusses management options for maple syrup producers in Ontario. Specific reference is made to sugar maple and black maple. Topics covered include thinning practices, tree marking, protection of the sugar bush, and methods for transplanting trees. A section also provides information on management-related assistance that is available to Ontario maple syrup producers.

Report
OMNR Library

66. Corlett, A. 2000. Why should we be concerned about oak? *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

Red oak stands are examined from a commercial and ecological perspective. In Ontario, most red oak stands are mature with very little natural regeneration occurring. Abundance of red oak is declining in Ontario due to increases in fire occurrence at the turn of the century, followed by effective fire suppression activity from the mid-1920s to present. High-grading occurred in the early 1920s, followed by an emphasis on the selection system, from the mid-1970s to the present. This encouraged shade tolerant (sugar maple, beech) species, and discouraged mid-tolerant species (red oak, white ash and black cherry). The establishment of red oak involves costly pre- and post-harvest silvicultural effort. Scientists at the Ontario Forest Research Institute and the northern states are being approached for advice on the red oak problem. In 1985 and 1988, a Red Oak Strategy was developed to identify research priorities.

Proceedings
Ontario Forest Research Institute (SSI)

67. Cormier, D., Paterson, J. 1997. A comparison of five site preparation methods in central Ontario. For. Engin. Res. Inst. Can., Pointe-Claire, QC. Silv. Note TN-264. 7 pp.

FERIC undertook a comparison of 5 site preparation methods (scalping with a bulldozer, scalping with an excavator, windrowing, mulching of the full site, and strip mulching) in central Ontario. The study was designed to measure equipment productivity, assess the results in terms of microsite quality, and calculate the costs of the various operations. The results suggested that each treatment could be effective under certain conditions. The choice of an optimal treatment within the study conditions should be facilitated by biological follow-ups that will be carried out by the Ontario Forest Research Institute over the next few years.

Report
Ontario Forest Research Institute

68. Creasey, K.R. 1990. Red oak regeneration seminar. Unpubl. Rep. 4 pp.

This article, which is a copy of a seminar speech given in 1990, describes several aspects relating to artificial regeneration of red oak. The first section covers acorn collection, the importance of high quality seed, and germination capacity. The effects of attacks by weevil, other insect predators and pathogens on acorns and methods for seed handling and storage are explained. A final section on seed shipment describes methods to ensure the minimum loss of seed viability between shipping and sowing.

Report
Ontario Forest Research Institute (SSI)

69. Crombie, G.N. 1965. The effectiveness and costs of various treatments to eliminate undesirable hardwoods. Ont. Dept. Lands For., Silvic., Toronto, ON. Note No. 1. 12 pp.

This study was conducted to determine a practical and economical method of removing cull trees and undesirable hardwood stems in areas suitable for polewood stand improvement. Gradual removal was achieved using: notch girdling, double frill, single frill, single frill and herbicide, partial frill and herbicide, and partial frill. Six 1-ac (0.4 ha) plots were established in late March 1961 in Cardiff Township, Haliburton County, Lindsay Forest District. The portion of the stand treated varied from 1/4 to 1/3 of the basal area and averaged approximately 28 $ft^2$/plot (2.60 $m^2$/plot). This study indicated that notch-girdling was a practical and effective treatment for killing cull hardwoods and that the cambium must be completely severed. Girdling or frilling of stems under 4 in. (10.2 cm) DBH was inefficient. These trees should be cut down if removal is desired. Codominant coppice growth should be cut rather than girdled, especially in the case of basswood.

Report
OMNR Library

70. Daly, E.G. 1950. Improvement cutting in BwA-H type. Petawawa For. Exp. Stn., Petawawa, ON. Project P-15. Unpubl. Rep. 10 pp.

An experiment was initiated in 1922 to examine the effect of an improvement cut on the growth and development of the residual stand. Mature poplar were thinned in a tolerant hardwood stand to improve the spacing and species composition in the understorey. In each section, the trees were tagged and the diameters, along with the stumps were tallied and recorded. Stand tables before and after the cut are presented for each section. Volume tables were used to produce height-diameter curves for the major species. As no control plot was established for this experiment, comparisons with undisturbed conditions are not possible. The diameter growth of white birch did not appear to increase after the plot was thinned. All species except basswood and yellow birch increased in basal area at a rate of 2.5% or more, and appeared to grow at a satisfactory rate. Very little windfall damage occurred after treatment. The thinning of the stand resulted in a dense growth of hard maple regeneration.

Report
Petawawa Research Forest

71. Daly, E.G. 1950. Thinning in ByM-BS PSP 16. Petawawa For. Exp. Stn., Petawawa, ON. Unpubl. Rep. 10 pp.

This study looked at the effect of hardwood overstorey removal on the growth and development of the suppressed understorey trees. The experiment was conducted on one permanent sample plot in June 1920. In October 1920 most of the hardwoods over 4 in. (10.2 cm) DBH were removed and used as fuelwood. Trees in the main stand were tallied before and after thinning. Coniferous trees in the understorey were tallied by diameter at stump height. The plot was remeasured at 5-year intervals. Height-diameter curves were constructed for the major species at each remeasurement and stand tables of number of trees, basal area, and total cubic foot volume compiled. Since a control plot was not established for this experiment, it is not possible to draw any definite conclusions from the data. There is sketchy evidence from the diameter growth curves that the diameter growth of some trees of each species were stimulated. The number of new trees entering the stand also indicate that the coniferous portion of the stand is increasing. However, this may be the result of adaptability to the site rather than the result of the treatment.

Report
Petawawa Research Forest

72. Daly, E.G. 1951. Selection cutting in ByM-BS cover type. Petawawa For. Exp. St., Petawawa, ON. Project P-30. Unpubl. Rep.18 pp.

This report examines the effects of logging mature poplar on the residual stand. During the winter of 1921-1922, approximately 50 ac (20.2 ha) of an uneven-aged mixedwood stand was cutover for mature poplar. The stand was situated in the Headquarters Block at the Petawawa Forest Experiment Station. This area was logged again in the winter of 1929-1930, at which time, all balsam poplar, mature and overmature hardwoods were removed. In the summer of 1931, 3 permanent sample plots were established in the cut-over area to study the effect of logging on the growth and development of the residual stand and natural regeneration. Analysis of data collected from the plots between 1931 and 1948 indicated that the area was well stocked with young hard maple and soft maple. Moderate cutting was more beneficial to the growth and development of the residual stand than severe or light cutting. However, the advantages of moderate cutting were wasted on residual trees of low quality. The logging operation failed to produce conditions favourable to the establishment of conifers. Overall, the logging operation was unsuccessful because it produced a stand of low grade hardwoods. It was recommended that the project be discontinued.

Report
Petawawa Research Forest

73. Davis, S., Seburn, D., Roach, T. 2002. Forestry Forum. Eastern Ontario Model Forest, Kemptville, ON. 3 (21). 4 pp.

This newsletter discusses a workshop series that is being offered for woodlot owners, forest consultants, and loggers on logging damage in the Hopetown area and efforts underway to protect the Alfred Bog. A Veterans Way Committee has been established to study a proposal for the Veterans Way and the Arboretum in Kemptville.

Report
National Library of Canada

74. Dey, D.C. 1993. The role of fire in the development and management of yellow birch and red oak in Ontario. *In* Proceedings: Prescribed Burning Workshop, Sept. 22-23, 1993, Petawawa, ON., Ont. Min. Nat. Resour., Central Ont. Sci. Technol. Devel. Unit., North Bay, ON.

The role of fire in preparing adequate seed beds and in controlling understorey competition for light is discussed.

Proceedings
Ontario Forest Research Institute

75. Dey, D.C. 1994. Careful logging, partial cutting and the protection of terrestrial and aquatic habitats. Pp. 53-69 *in* Rice, J.A., (ed.) Logging Damage: The Problems and

Practical Solutions. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 117. 70 pp.

Stand management activities influence (1) tree diameter growth and tree quality; (2) stand structure, stocking and composition; (3) aquatic and wildlife habitat quality; and (4) long-term site productivity. The cumulative impacts of stand-level treatments affect ecosystem structure and function at the landscape level. Rigorous administration of road construction and timber harvest activities is necessary for the successful implementation of forest management plans.

Report
Ontario Forest Research Institute

76. Dey, D.C. 1995. Acorn production in red oak. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 127. 22 pp.

When managing oak forests, aspects of acorn production for natural regeneration and wildlife are important. Acorn production depends on weather, site productivity, wildlife and insect activity, and individual tree characteristics. Acorn production is associated with crown size, crown class, tree age, and DBH. When the stand is thinned, it can increase the amount of oak in the upper crown classes. As a result, individual trees will be promoted for good acorn production. It is important to identify good acorn producers before a stand is thinned to ensure that they are retained. If stocking is maintained between the recommended upper and lower stocking limits, the complete use of growing space by trees will be ensured. When a forest stand's stocking approaches the upper limit, it should be thinned back to approximately the lower limit. This will maintain oak in the upper crown classes and allow for maximum development of tree characteristics that are known to influence acorn production. This paper includes a method for estimating acorn production and preliminary guidelines for acorn management.

Report
Ontario Forest Research Institute

77. Dey, D.C., Buchanan, M. 1995. Red oak (*Quercus rubra* L.) acorn collection, nursery culture and direct seeding: A literature review. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 122. 46 pp.

The regeneration of red oak by planting or direct seeding is an important method for restoring oak in ecosystems where it has been lost as a result of past management practices. Planting and direct seeding can also be used to supplement natural regeneration of oak and to ensure that sufficient oak reproduction is in place when overstories are removed through timber harvests. There has been a substantial amount of research conducted on the nursery production of bare root and container-grown red oak and the direct seeding of oaks throughout eastern North America. This paper is a review and synthesis of existing information. Recommendations on seed collection, nursery cultural practices, stock quality and direct seeding techniques are presented.

Report
Ontario Forest Research Institute

78. Dey, D.C., Guyette, R.P. 1996. Early fire history near Papineau Lake, Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Note 54. 4 pp.

Site-specific fire histories that document fire frequency, fire behaviour, fire effects on natural regeneration and growth, and the influence of human activities, are being developed in upland red oak-pine ecosystems in central Ontario by the Great Lakes-St. Lawrence silviculture program. This report presents the fire history from 1634 to 1875 of an oak-pine stand near Papineau Lake, Ontario. Fire scars in old white pine stumps were used to develop the fire chronology.

Report
Ontario Forest Research Institute

79. Dey, D.C., Guyette, R.P. 1996. Early fire history near Seguin Falls, Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Note No. 55. 4 pp.

This report is one of a series of site-specific fire histories developed for red oak-pine ecosystems in central Ontario. Collectively, these studies document the role of fire in upland oak forests and provide an ecological basis for developing silvicultural prescriptions that use prescribed burning to promote oak regeneration and maintain or restore fire-dependent forests by emulating natural disturbance processes. By dating fire scars on cross-sections cut from old white pine stumps, a fire chronology was developed, using sampling and dendrochronological methods, for an oak-mixed hardwood-pine site for the period 1656 to 1861. Man-caused fires (Aboriginal travel routes and village sites, as well as historical First Nations vs. fur trader conflicts) were probably largely responsible for the variability in fire frequency during this period.

Report
Ontario Forest Research Institute

80. Dey, D.C., Guyette, R.P. 2000. Anthropogenic fire history and red oak forests in south-central Ontario. For. Chron. 76(2): 339-347.

Fire is strongly associated with dominance and natural regeneration in red oak in eastern North America. The focus of this study was to investigate if red oak abundance was due to the result of anthropogenic burning and natural fires. These fires allow red oak to regenerate and become more dominant than shade-tolerant species. Fire chronologies were determined based on analyses of fire scars on stumps, trees, and natural remnants of red pine, white pine, and red oak at 6 sites in south-central Ontario. Mean fire interval varied among sites and was associated with the migration of historic Aboriginal and European populations. Mean fire interval varied between 6 and 70 years depending on the historic period and site location. Anthropogenic fire regimes influence the occurrence and abundance of red oak.

Journal paper
OMNR Library

81. Dey, D.C., Parker, W.C. 1996. Regeneration of red oak (*Quercus rubra* L.) using shelterwood systems: Ecophysiology, silviculture and management recommendations. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 126. 59 pp

Different user groups are becoming more interested in developing reliable methods for regenerating red oak in Ontario. Traditional silvicultural methods have been unsuccessful in sustaining the oak growing stock. This paper reviews the ecology, physiology, and reproductive biology of red oak. Knowledge of seedling ecophysiology and regeneration ecology are necessary to ensure that further development of the shelterwood method for regenerating red oak will occur. Recommendations for new silvicultural practices are provided.

Report
Ontario Forest Research Institute

82. Dey, D.C., Parker, W.C. 1997. Morphological indicators of stock quality and field performance of red oak (*Quercus rubra* L.) seedlings underplanted in a central Ontario shelterwood. New For. 14: 145-156.

The value of initial diameter near the root collar, shoot length, and number of first-order lateral roots (FOLR) as morphological indicators of stock quality and field performance was examined for bare root red oak underplanted in a shelterwood in central Ontario. Initial diameter, shoot length, and number of FOLR were positively and significantly correlated with second year height and diameter. Of the 3 indicators, diameter was also the best predictor of several physical characteristics of root systems 2 years after planting. Stem diameter 2 years after planting was more strongly related to root volume, area, and dry mass than was initial diameter, the probable result of adjustment in root-shoot balance of planting stock to the shelterwood environment.

Journal paper
OMNR Library

83. Dey, D.C., Parker, W.C. 1997. Overstorey density affects field performance of underplanted red oak (*Quercus rubra* L.) in Ontario. North. J. Appl. For. 14(3): 120-125.

This study involved underplanting red oak seedlings in a closed-canopy mature northern hardwood stand and in an adjacent shelterwood in central Ontario. Two years after planting, overstorey density effects on seedling survival and growth were assessed. Also, seedling survival was 90% in the uncut stand and over 99% in the shelterwood. In uncut stands, seedlings experienced insignificant or negative annual increments for stem height and diameter. After 2 years, seedlings in the shelterwood were approximately 2 mm larger in diameter and nearly twice as tall as those in the uncut stand. In the shelterwood and uncut stand, second-year stem diameter and height distribution of planted oak were significantly different. Seedlings grown in the shelterwood appeared to have substantially larger root volume, area, and dry mass than those in uncut stands. Researchers suggested that if red oak is underplanted in an uncut stand 2 or more years before a shelterwood harvest, it will experience too much competition once it is released. Ideal requirements for growing red oak occur in forests where shelterwoods provide adequate light to the forest floor. When the final overstorey is removed, a strong positive growth response will follow.

Journal paper
OMNR Library

84. Dillabough, B.J. 1983. Site index comparisons among northern hardwood and softwood tree species in southern Ontario. Lakehead University, School of Forestry. Thunder Bay, ON. B.Sc.F. Thesis. 62 pp.

This study occurred across 17 counties in southern Ontario. The focus of the study was to examine 20 different compositions of northern hardwood and softwood species. Results were compared with 2 studies in the Lake States and one study in eastern Ontario. Data from the Lake States studies can be applied to hardwoods and softwoods in southern Ontario.

Thesis
Lakehead University

85. Drysdale, D.P. 1983. Ontario Tree Improvement and Forest Biomass Institute: Forest research 1981-1982. Ont. Min. Nat. Resour. Maple, ON. 42 pp.

This annual summary of selected research activities of the Ontario Tree Improvement and Forest Biomass Institute describes some of the work and findings in studies ongoing in 1981-82, including breeding, productivity, and the requirements of poplar, willow and alder; tree improvement and genetics, including tissue culture, of spruces, pines, larch, and some hardwoods; physiological and morphological studies on the production and performance after outplanting of coniferous planting stock; and stand management and productivity investigations in natural and planted conifer and hardwood stands.

Report
Ontario Forest Research Institute

86. Dumbroff, E.B., Webb, D.P. 1978. Physiological characteristics of sugar maple and implications for successful planting. For. Chron. 54(2): 92-95.

This study addresses the challenges of sugar maple seedling establishment on open field sites in southern Ontario. The following phenological patterns associated with sugar maple seedlings are examined (1) root growth; (2) dormancy and bud break; (3) changes in carbohydrate reserves; and (4) the activity of endogenous hormones. Sugar maple seedlings should be planted between soil thaw in mid-March and bud break in early May. If transplanting occurs too late in the spring, severe damage to the active root system can occur. Further research is required to produce seedlings with favourable physiological characteristics, improve planting equipment, and examine the benefits of fall planting.

Journal paper
OMNR Library

87. Ecological Services for Planning, Ltd. 1991. Final report Northeastern Region tolerant hardwood growth and yield study results of stem analysis in nine tolerant hardwood stands in Sault Ste Marie District, Ontario. Ont. Min. Nat. Resour., Central Ont. For. Technol. Devel. Unit, North Bay, ON. Tech. Rep. No. 20. 102 pp.

In 1991, this study was initiated by OMNR's Sault Ste. Marie District. The focus of the study was to obtain preliminary growth and yield information for tolerant hardwood stands in the Sault Ste. Marie area. Objectives of the study were to estimate potential volume of tolerant hardwoods and natural stands by soil and site type, determine variable rotation ages by site type for tolerant hardwoods, and to assign a maximum mean annual increment value by site type to use as an index of productivity in the Northeastern Region Forest Management Potential Model (FOMAP).The tolerant hardwood stands had a variable distribution of species composition that occurred from stand to stand and within stands. The most dominant species in the overstorey appeared to be sugar maple and/or yellow birch, while the most dominant subcanopy was sugar maple. Trends in the data were found, however, they could not be quantified with any degree of confidence. The volume increment of individual trees was related to the average distance of a tree from its neighbours.

Report
OMNR Library

88. Ellis, R.C. 1973. Hardwood woodlot silviculture (Thinning and fertilizer experiments). Pp. 31-41 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

This paper presents a brief review of the problems of partial cutting (thinning) in southern Ontario hardwood stands containing mixtures of sugar maple, white ash, black cherry, and basswood. Results of a thinning and fertilizing study to improve the growth response of residual tress are presented.

Proceedings
OMNR Library

89. Enright, L. 1998. Effects of selection logging on amphibian diversity and abundance in shade-tolerant hardwood forests of Algonquin Provincial Park, Ontario. Univ. Guelph, Guelph, ON. M.Sc. Thesis. 84 pp.

This thesis focuses on determining how selection harvests affect amphibians in tolerant hardwood forests. Amphibian habitat was compared with amphibian diversity and abundance in both managed and unmanaged forest stands. The overall diversity and abundance of amphibians did not differ significantly between managed and unmanaged areas. The only exception was American toads, which were more abundant in managed stands. The general conclusion from this study was that selection logging in hardwood forests does not change amphibian habitat enough to adversely affect their diversity or abundance.

Thesis
Univ. Guelph Library

90. Fayle, D.C.F. 1965. Rooting habit of sugar maple and yellow birch. Dept. For., Ottawa, ON., Publ. No. 1120. 31 pp.

Development of the root system of sugar maple, growing on various soil types and site conditions in Ontario, is presented in photographs and described from seedling to maturity. Comparisons are made with yellow birch. The effect of environment on root development is discussed. Sugar maple has a more intensively developed central root system and a less developed extensive root system than yellow birch. Both root to the same depth. Yellow birch is apparently more adaptable than sugar maple to a range of soil depth conditions.

Report
OMNR Library

91. Fayle, D.C.F., Bentley, C.V. 1988. Temporal changes in growth-layer patterns of plantation-grown red oak and red pine. Can. J. For. Res. 19: 440-446.

This study took place at the Midhurst Tree Nursery near Barrie, Ontario, in a 50-year-old red oak and red pine plantation on a fine sandy soil. Dominant and intermediate representatives of both species were felled and cross sections were cut from the stems. An examination of the radial and longitudinal patterns of ring widths revealed that red pine has similar patterns to conifers grown in single-species stands. Overall, the oak had different patterns than that of the pine because of different branch development. However, similar radial and ring-number sequences occurred between the 2 species. Periodically, the oak appeared to have reduced height increment, possibly attributable to a reduction in ring width in the upper stem relative to the lower stem.

Journal paper
OMNR Library

92. Fayle, D.C.F., MacDonald, G.B. 1977. Growth and development of sugar maple as revealed by stem analysis. Can. J. For. Res. 7(3): 526-536.

Patterns of annual height and radial growth over a 50- to 60-year period are discussed for 3 16- to 18-m-tall intermediate crown class sugar maples. Changes in ring width patterns at breast height appeared to be a good indicator of growth performance as they were correlated with specific volume increment.

Journal paper
OMNR Library

93. Fleck, B. 2000. Case study: Bancroft District oak management. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

Three projects at Watt Lake, Papineau Lake, and Yuill Lake attempted to establish red oak on sites where it was either a minor component or did not occur prior to treatment. The effects studied included prescribed fire(s), herbicide application, and canopy closure on the development of red oak and its competitors. On the Watt Lake trial, increasing the light level thinning from below was important. At Yuill Lake, regeneration was most successful where white birch and sugar maple stands were clearcut, followed by prescribed burning and planting of quality oak seedlings. The use of prescribed fire to release oak regeneration will be most successful where beech and sugar maple were the main competitors. On the Papineau study, maintaining a shelterwood canopy, applying light to moderate fire, and planting quality seedlings resulted in the best oak regeneration stocking and growth.

Proceedings
Ontario Forest Research Institute (SSI)

94. Folkema, M.P. 1995. Hardwood thinning trials with a farm tractor, skidding winch and grapple-loader trailer. For. Engin. Res. Inst. Can., East. Ont. Model For, Kemptville, ON. Inf. Rep. No. 17. 30 pp.

This study, located in the Eastern Ontario Model Forest, was designed to test promising techniques and equipment suitable for hardwood thinning operations. In the first half of the operation a farm tractor, logging winch, and skidder were used. There was less logging damage to residual trees from the tractor and winch than from the skidder. In the second half of the operation, logs were winched to the skid trail and extracted to the landing with a grapple-loader trailer. This second method worked very well because the residual stand was well spaced and there was no significant damage to the residual trees.

Report
OMNR Library

95. Forsyth, L. 2000. Case study: Lanark Area oak prescribed burn. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

This discussion focuses on prescribed burning for oak regeneration on south-facing slopes. The burn intensity and the impact on residual overstorey trees may need to be lessened, depending on the site.

Proceedings
Ontario Forest Research Institute (SSI)

96. Foster, N.W., Nicolson, J.A., Hazlett, P.W. 1989. Temporal variation in nitrate and nutrient cations in drainage waters from a deciduous forest. J. Environ. Qual. 18(2): 238-244.

This study occurred in a sugar maple/yellow birch forest in the Turkey Lakes watershed in 1984. Ca, Mg, K, Na, H, ammonium, nitrate, sulfate, Cl and bicarbonate ions in soil solution at 0 to 90 cm depth and in streamwater were monitored. Researchers reported that the main anion associated with soil cation depletion was nitrate. Nitrogen that occurred in precipitation was not as important as soil nitrogen when determining solution chemistry. During the growing season, soil solution ammonium and nitrate were the highest in the Oe horizon. Moving downwards from the B to C horizon, the soil solution ammonium and nitrate decreased. The highest nitrate concentrations in soil solution and streamwater occurred during snowmelt. During the winter, stream nitrate was correlated with soil nitrate and Ca. Nitrate contributed less to cation fluxes in streamwater than bicarbonate or sulfate.

Journal paper
OMNR Library

97. Fox, B., White, K., Nichols, J. 1991. Silvicultural demonstration areas of the Kirkwood forest. Ont. Min. Nat. Resour., Central Ont. For. Technol. Devel. Unit. North Bay, ON. 22 pp.

This section of the report summarizes work that has been accomplished on tolerant hardwoods in the Kirkwood Forest, which consists of 17 townships located on the west side of Blind River District. There are photographs of 1979 and 1986 strip cuts, along with charts, and a discussion outlining the results from these studies. Maps, charts, photographs, and discussions also outline the following studies: spacing trials in juvenile tolerant hardwoods in Gould Township; 1987 tolerant hardwood improvement cut, Stand 49, Bridgeland Township; and a 1987 red oak planting, Stand 156-1, in Bridgeland Township.

Report
OMNR Library

98. Fraser, D.A. 1957. Annual and seasonal march of soil temperature on several sites under a hardwood stand. Can. Dept. North. Aff. Nat. Resour., For. Br., Ottawa, ON. Tech. Note No. 56. 15 pp.

This study took place in Petawawa, Ontario at the Petawawa Forest Experiment Station under a hardwood stand. Soil temperature variations on the same plot during all seasons for the last 3 years of the 1949-55 period were recorded. The data provides changes in soil temperatures on different sites at various depths and supplies information on conditions during the more adverse part of the year. Soil temperature data from the 2-, 3-, 12-, 36-, and 108-in (274 cm) depths were compared with air temperatures at the 48-in (122 cm) level for the 1949-56 period. Temperature differences between sites were greatest in the spring. The maximal soil temperature at the 2-in (5 cm) depth on the dry sites was 73° F (23° C) in the hot dry summer of 1955. During the cold wet summer of 1954 this maximum was about 63° F (17° C). Frost penetration was usually limited to the upper 2-3 in (5.0-7.6 cm) of soil since the winter snow cover formed an insulating layer. Maximum and minimum temperatures at the 108-in (274 cm) depth were 50° F (10° C) and 38° F (3° C).

Report
OMNR Library

99. Fraser, D.A. 1959. Nine years of observations on the condition of 241 yellow birch. Can. Dept. North. Aff. Nat. Resour., For. Br., For. Res. Div., Ottawa, ON. Tech. Note No. 69. 23 pp.

This report summarizes intensive studies that were conducted in May 1949 in an 8-ac 3.2 ha) plot in a hardwood stand containing yellow birch at the Petawawa

Forest Experiment Station. These studies examined the physical ecology of the stand and the physiology and growth responses of selected trees in various stages of decadence. This investigation provides information on the early case history of individual yellow birch trees if extensive dieback becomes established in Ontario. The crowns of 241 yellow birch trees were classified during the 1949-1957 period into Numerical Health Indices ranging from I (Healthy Crown) to X (Dead) and XI (Fallen). There was a progressive improvement in crown conditions from 1949 to 1951, followed by a gradual regression until 1957, when the health of the yellow birch was essentially the same as 9 years earlier. Crown changes had no relation to site differences on the experimental plot. Diameter growth of yellow birch was not reduced until the crown declined to an index of IV or higher. Defoliation of the hardwood species other than yellow birch in 1951 by a tent caterpillar infestation caused a temporary opening in the canopy and may have contributed to the improvement of yellow birch crowns at that time.

Report
OMNR Library

100. Gilbert, R.C.A. 1973. Herbicides in forest tree establishment. Pp. 90-94 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

This paper presents a brief review of the need for weed control in establishing forest plantations, and provides current recommendations on the types and application methods of specific herbicides for effective week control.

Proceedings
OMNR Library

101. Gillmeister, D. 1995. Yellow birch story: script for regenerating yellow birch video. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 66 pp.

This script contains narration, audio and video directions that were used in the making of the Regenerating Yellow Birch video (Ontario Forest Research Institute 1995).

Report
Ontario Forest Research Institute (Cole)

102. Goodwillie, R.N. 1975. Growth studies in the field layer of *Acer saccharum* forest in southern Ontario. Univ. Toronto, Dept. of Botany, Toronto, ON. M.Sc. Thesis. 138 pp.

In 1971, 13 sugar maple stands were examined for the phenology and seasonal production of herb species. The study took place in 3 locations: Dorset (Muskoka), Otter Lake (Bruce Peninsula), and Vellore (Toronto). At each location, both mature and young stands were sampled. Each stand has a site description explaining the tree crop, light conditions, soil characteristics, branch biomass, and composition of the non-herb fraction of the field layer. Phenology measurements were also taken and 5 herbaceous species were examined individually. Estimates are provided for the annual production of the herb species in each locality. These results are compared with species diversity, biomass, soil conditions, aspect, stand age, and other site variables. Herbaceous production from tree stem production is estimated using a regression analysis, along with conversion factors for estimating total herb biomass from data of above ground biomass.

Thesis
Univ. Toronto Earth Sci. Library

103. Gordon, A.M. 1985. Maintaining a red oak component in the hardwood forests of southern Ontario., Proposal to the Ontario Renewable Resource Research Fund Grant Program, Univ. Guelph., Dept. of Environ. Biol., Guelph, ON. 26 pp.

This research study investigates methodological variations in one proven method of regenerating red oak: underplanting high quality (1+1 clipped or large 2+0) red oak stock in a shelterwood situation. Before underplanting could occur, overstorey stocking was reduced by 60%.

After the initial overstorey removal., underplanting and removal of the residual overstorey occurred within 3 years. Four OMNR districts (Bracebridge, Minden, Huronia, and Lindsay) were partners in the study. Background information, the research proposal, budgets, letters of support, and literature cited are included in this report.

Report
Ontario Forest Research Institute (SSI)

104. Gordon, A.M. 1987. Post-harvesting silvicultural techniques to enhance the red oak component of shallow-site forests in central Ontario. Presented at USDA, Northeastern and North Central Forest Experiment Station, Broomall, PA. 1 p.

This study compared the outplanting performance of both 1+0 and 1+1 northern red oak stock underplanted in a shelterwood cut, and compared prescribed burning to herbicide application for controlling competition. Harvesting occurred leaving a basal area of 13.8 $m^2$/ha (60 $ft^2$/ac). All possible combinations of stock type (1+0, 1+1) and treatments (prescribed burn, herbicide, control) were tested. In the spring of 1986, 64 northern red oak seedlings were planted in each experimental cell. Glyphosate was applied twice (in 1986 and in 1987) at a rate of 2.0g/L around each tree after leaf flush. In 1987, the prescribed burn was conducted and the maple competition died off. Half the seedlings were clipped for biomass determination and allowed to resprout in 1988. A light prescribed burning initially stimulates height growth of planted oak seedlings. However, if this burning is not repeated, it is not useful in the longer term. Larger stock (1+1) responds better to burning than smaller (1+0) stock, however, the opposite is true if competition is controlled by herbicides.

Report
Ontario Forest Research Institute (SSI)

105. Gordon, A.M. 1988. Graded northern red oak planting stock: dimensions and outplanting performance. Tree Plant. Notes 39(4): 33-34.

Northern red oak stock was obtained from the Midhurst Nursery and graded before it was outplanted. Data collected from initial stem diameters and height growths of graded 1+0 and 1+1 northern red oak stock are presented. Stock grading did not appear to be useful if shoot clipping or prescribed burning was used after planting.

Journal paper
OMNR Library

106. Gordon, A.M. 2000. Ridout Township oak trial. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

This paper presents the establishment history and recent re-measurement data of a 2-cut shelterwood red oak underplanting in Ridout Township. The main focus of this study is to examine the implications of competition control using prescribed burning and herbicide on a typical red oak site. Topics covered include project history, experimental design, and the prescription. Light burning does stimulate height growth, but it needs to be repeated to be effective. Larger stock responds better to burning and, in general, responds better than smaller stock. However, the opposite is true if competition is controlled by herbicides. If larger stock is subjected to burning, it may respond poorly. Stock grading did not appear to be effective as a screening tool. A prescription of 2-cut shelterwood with underplanting on principal oak sites was successful. Red oak is highly competitive once established and responds well to late release.

Proceedings
Ontario Forest Research Institute (SSI)

107. Gottschalk, K. 2000. Making decisions about when to harvest oak. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind

For. Steward., Inc. 95 pp.

This discussion explores the theme of ecology versus economics for oak management. The owner's goals and issues of sustainability should be factored into harvesting and other management decisions. The regeneration objective, selection of trees to cut and leave during intermediate treatments, and rotation length are important components to consider.

Proceedings
Ontario Forest Research Institute (SSI)

108. Grinnell, W.R. 1957. The management of small forest areas in southern Ontario. Univ. Toronto, Faculty of Forestry. Toronto, ON. M.Sc.F. Thesis. 78 pp.

A framework of forest management methods designed to apply to townships, counties, conservation authority properties, and some crown areas is presented. Techniques for regulating the handling of uneven-aged stands are examined. Cruising and mapping methods, along with the method of a continuous inventory system by periodic remeasurement is provided. Strip and plot sampling is recommended. Regulations of plantations and woodlots are outlined that allow age class distribution to be relatively uniform. When plots are remeasured, inventory data can be secured, the allowable cut can be determined, yield data can be produced, and future thinning can be determined. Uneven-aged and even-aged stands should be included for formula regulation until continuous inventory variation can be applied.

Thesis
Univ. Toronto Earth Sci. Library

109. Gross, H.L. 1984. Defect associated with *Eutypella* canker of maple. For. Chron. 60(1): 15-17.

Twenty-seven sugar maple (*Acer saccharum* Marsh.) trees bearing cankers caused by *Eutypella parasitica* fungus were dissected to determine the extent of internal defect. In all cases, defect associated with the cankers was of a type that should be eliminated by cutting out the defective portion of the stem. Regression models presented show that internal defect length was a function of the external length of the canker, and that defect usually extended only a short distance beyond the canker margin. Valuable, sound wood is lost when loggers do not cut cankered trees.

Journal paper
OMNR Library

110. Gross, H.L. 1984. Impact of *Eutypella* canker on the maple resource of the Owen Sound and Wingham Forest Districts. For. Chron. 60(1): 18-21.

The importance of cankers caused by *Eutypella parasitica* fungus was assessed in sugar maple stands of the Owen Sound and Wingham districts in southwestern Ontario. In the Owen Sound District, *Eutypella* cankers occurred on 7.4% of the sugar maples. Cankered trees had an average cull loss of 12.4% total cubic volume and 49.2% merchantable cubic volume. In the Wingham District, where maple stands are better quality timber than the Owen Sound District, the incidence of cankering was significantly less. The frequency of *Eutypella* canker affected the percentage content of maple in a stand, maple tree density, and maple tree size. Cull loss due to cankers appeared to be related to canker size, tree size, and the position of the canker on the tree stem.

Journal paper
OMNR Library

111. Guyette, R.P., Dey, D.C. 1995. A history of fire disturbance, and growth in a red oak stand in the Bancroft District, Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 119. 14 pp.

Disturbance is integral to the regeneration and growth of northern red oak in Ontario, and historically fire has favoured red oak regeneration. In this report, the authors examine the occurrence of fire, and the effects of fire and climate on the growth and regeneration of northern red oak in central Ontario.

Report
Ontario Forest Research Institute

112. Guyette, R.P., Dey, D.C. 1995. A presettlement fire history in an oak-pine forest near Basin Lake, Algonquin Park, Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Rep. No. 132. 7 pp.

Fire scars from natural remnants of red pine in an oak-pine forest near Basin Lake, Algonquin Park, Ontario, were dated using dendrochronological methods. A fire scar chronology was constructed using 28 dated fire scars on 26 pine remnants found in a 1 $km^2$ area of this forest. Pith and outside ring date distributions indicated that 2 stand replacing fires occurred. The composite fire scar chronology spanned 191 years from 1665 to 1856. The fire return interval between the stand replacing fires was approximately 200 years. Fires of moderate or greater intensity had a return interval of 68 years, while low-intensity fires had a mean interval of 22 years. During the period of the highest fire frequency between 1733 and 1780, the fire return interval for the area was 11.8 years.

Report
Ontario Forest Research Institute

113. Guyette, R.P., Dey, D.C., McDonell, C. 1995. Determining fire history from old white pine stumps in an oak-pine forest in Bracebridge, Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Rep. No. 133. 9 pp.

Fire scars on stumps of white pine in a red oak-eastern white pine forest near Bracebridge, Ontario, were dated using dendrochronological methods. A chronological record of fires that caused basal scarring is preserved in the remnant white pine stumps, which were estimated to be up to 135 years old. A tree ring chronology was developed for the site and then dated in absolute time by comparing it with a white pine chronology derived from living trees in the same region. An abrupt increase in fire frequency after 1741 is attributed to increases in human population levels as Natives and Europeans reoccupied the area. The frequent fires between 1741 and 1810 are hypothesized to have advanced the regeneration and dominance of red oak over sugar maple and contributed to the present dominance of red oak in the overstorey.

Report
Ontario Forest Research Institute

114. Hamilton, P. 1999. Clearcuts, shelterwood cuts, and selection cuts in the Turkey Lakes watershed. For. Engin. Res. Inst. Can., Pointe-Claire, QC. Tech. Note TN-295. 11 pp.

This study took place in the Turkey Lakes watershed in central Ontario. Researchers examined manual and mechanized felling operations that used extraction by a cable skidder. This study compares manual and mechanized clearcutting and partial-cutting operations. Clearcutting was the operation with the highest felling and extraction productivity. The method chosen for forest operation, and the type of harvesting system used were equal in their effects on site disturbance.

Report
Ontario Forest Research Institute (SSI)

115. Harmer, R., Baker, C.A. 1991. Vegetative propagation of oak using coppice shoots. For. Comm. Res. Div., Silvicult. and Seed Res. Br., Farnham, Wrecclesham, Surrey, G.B. Res. Inf. Note No. 198.

This article describes coppice shoots as a method for the vegetative propagation of oaks. The origin and growth of coppice shoots is discussed as well as methods for using these shoots including collection, preparation, growing environment, rooting and overwintering, along with the problem of oak mildew. A practical example using the collected shoots is presented.

Report
Ontario Forest Research Institute (And.)

116. Hayden, J., Boysen, E.P., Woods, M.E., Rice, J.A. 1999. Making cents out of forest inventories: a guide for small woodlot

owners., Ont. Min. Nat. Resour., Sault Ste. Marie, ON. Sci. Devel. Trans. Ser. 002. 32 pp.

This report suggests where and how you might collect woodlot management information and the type of inventory information required. Information on basic skills, such as timber cruising and compiling data, is provided. For those who are involved with the Managed Forest Tax Incentive Program, a program designed by the OMNR to allow qualifying landowners to have their property reassessed and classified as Managed Forest, this manual will help them fulfill the associated obligations.

Report
Ontario Forest Research Institute

117. Hayden, J., Woods, M.E., Boysen, E.P., Mackenzie, J., Lewis, W., Richard, B., Brodzik, Z., Matuszyk, J., Miller, R.J. 1996. Ontario Forest Growth and Yield Program 1995-1996 annual report. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 17 pp.

The primary objective of the Ontario Forest Growth and Yield Program is to provide data, information, and knowledge that will advance sustainable resource management planning. This annual report is a breakdown of the provincial and regional components of the program, and provides information about work completed to date, as well as ongoing projects.

Report
Ontario Forest Research Institute

118. Hazlett, P.W., Foster, N.W. 1989. Source of acidity in forest-floor percolate from a maple-birch ecosystem. Water, Air Soil Poll. 46(1-4): 87-97.

This study examines sugar maple and yellow birch from 1982 to 1984. The aim of this study was to determine sources of acidity and the extent of leaching from forest-floor horizons. During the growing and dormant season, volume-weighted concentrations and ion fluxes in throughfall and forest-floor percolate were calculated. In the dormant season, hydrogen ion content of the forest-floor percolate decreased; in the growing season, the hydrogen ion content increased. The flux of hydrogen on the forest floor in the dormant and growing periods was due to hydrogen deposition in throughfall. When forest floor percolate was examined, Ca concentrations were positively correlated with $SO_4$, $NO_3$, and organic anions during both dormant and growing seasons. Critical factors influencing cation mobility in the forest floor appeared to be sources of $NO_3$ and organic anions within the ecosystem and major external inputs of $NO_3$ and $SO_4$.

Journal paper
OMNR Library

119. Hemming, D.R. 1951. Cutting methods in overmature hardwoods (Sugar bush). Can. Dept. Env. Petawawa For. Exp. Stn., For. Br., Petawawa, ON. Project No. P-71. 15 pp.

This report outlines a project that was started in 1935, based on a proposal to bring the Petawawa Forest Experiment Station (PFES) under intensive management. The stand, Sub-compartment 519, Compartment F at the PFES, was dominated by tolerant hardwoods interspersed with white pine and hemlock. Forest harvesting occurred from 1938 to 1943, but deviated from the recommended prescription. The area recommended to be clearcut was partially cutover and the control area was left in its natural state. The remaining part of the experimental area was cutover indiscriminately during the war years and the area now varies in appearance from one that has been clearcut to one that has been cut over selectively. It has therefore been recommended that this project be closed as the original objectives were not met.

Report
Petawawa Research Forest

120. Hill, A.W., Sinclair, G.A. 1954. Survey of the condition of birch in Ontario. Can. Dept. Agric., Sci. Serv., For. Biol. Div., Ottawa, ON. 24 pp.

An intensive survey of yellow birch stands was established to record any visual evidence of changes in tree vigour that might occur

from year to year. Twenty-three permanent sample plots were established, ranging from the Sault Ste. Marie District in the west, to the Petawawa Forest Experimental Station in the east.

Report
Ontario Forest Research Institute

121. Holowacz, J. 1960. Progress report on prescribed burning in the hard maple-yellow birch cover type in Ontario 1958-1959. Ont. Dept. Lands For., Res. Br., Maple, ON. For. Sec. Rep. No. 37. 16 pp.

A prescribed burning experiment was started at the Swan Lake Research Reserve, Algonquin Park, in the fall of 1958. The object of the experiment is to investigate the effects of fire on the hardwood stands of that area and to explore the possible use of fire as a silvicultural tool. The plan was to burn some parts of the area each fall over a 5-year period to secure areas with 1, 2, 3, or more successive burns for comparison. Preliminary results obtained 8 months after the first burn show that more than 90% of the sugar maple regeneration less than 0.6 inches (1.5 cm) DBH was eliminated. The first of the series of prescribed burns did not significantly reduce the number or damage the trees greater than 0.6 inches (1.5 cm) diameter. Due to adverse weather conditions, the 1959 fall burn did not occur.

Report
OMNR Library

122. Honer, T.G., Ker, M.F., Alemdag, I.S. 1983. Metric timber tables for the commercial tree species of central and eastern Canada. Can. For. Serv., Mar. For. Res. Cent., Fredericton, NB. Inf. Rep. M-X-140. 139 pp.

Metric timber tables are provided for 21 major commercial species of central and eastern Canada, based on a mathematical conversion of existing volume and diameter equations. Four types of tables are included: (1) total volume; (2) merchantable volume (stump height of 0.15 m and top diameter inside bark of 7.0 cm); (3) ratios of merchantable volume to total volume for various stump heights, top diameters, and merchantable lengths; and (4) diameters inside and outside bark for stump height, breast height, and sections of the lower bole.

Report
OMNR Library

123. Hough, M. 1973. Aesthetic and amenity values in the management of hardwood forests. Pp. 42-52 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

This paper presents a history of the development of North American forest aesthetics values and how they affect our current perceptions of forestry, harvesting and forest planning.

Proceedings
OMNR Library

124. Hughes, E.L. 1955. Cooperative underplanting and release experiment: a progress report. Ont. Dept. Lands For., Res. Div., Maple, ON. 10 pp.

Progress of the experiment, where underplanting and release of white pine, red pine, and white spruce on Crown land were the main considerations through 1954. The final report was released in 1956 under the same title.

Report
Ontario Forest Research Institute

125. Hughes, E.L. 1956. Cooperative underplanting and release experiment. Ont. Dept. Lands For., Res. Div., Maple, ON. For. Sect. Rep. 10. 6 pp.

Three-year survival and growth of white pine, red pine and white spruce underplanted in 3 combinations of soil and hardwood cover was reported.

Report
Ontario Forest Research Institute

126. Jaciw, P. 1973. Development of a hardwood stand in southwestern Ontario ten years after thinning. Ont. Dept. Lands For., Res. Div., Maple, ON. Unpubl. Rep. 15 pp.

A hardwood stand was experimentally thinned with areas of heavy thinning, light thinning and controls. The results of developments 10 years after treatment are presented.

Report
Ontario Forest Research Institute

127. Jaciw, P. 1973. Research on uplands in southern Ontario. Pp. 118-126 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

This is a review of some of the more recent work on upland hardwood management summarized under the following headings: (1) location and selection of high-quality phenotypes; (2) propagation techniques; (3) establishment methods; and (4) management methods.

Proceedings
OMNR Library

128. Jaciw, P. 1973. Upland hardwoods: A guide to the establishment of mixed stands on open forest sites. Ont. Dept. Lands For., Res. Div., Maple, ON. Unpubl. Rep. 10 pp.

Some of the principal considerations for hardwood management in mixed stands include site amelioration, site use, symbiotic influences, ecological balance, stand sanitation, and industrial, social, and aesthetic effects.

Report
Ontario Forest Research Institute

129. Jarvis, J.M. 1956. An ecological approach to tolerant hardwood silviculture. Can. Dept. North. Aff. Nat. Resour., For. Br., For. Res. Div., Ottawa, ON. Tech. Note No. 43. 43 pp.

Areas of uncut timber are limited and these are being used rapidly. Therefore, it is urgent that practical silvicultural methods be developed for treating the hardwood stands to ensure future crops of good quality trees. In 1950 and 1951, the Forestry Branch conducted surveys throughout the northern range of the maple-birch-beech types in Ontario and Quebec to obtain information on the condition of tolerant hardwoods and their proper silvicultural management. This report summarizes the results of the study, relates the findings to the ecology of the various tolerant hardwood associations, and offers suggestions for the silvicultural management of these forests. These surveys took place in Laurentian, Algonquin-Pontiac, Middle Ottawa, Georgian Bay, and Algoma, and the results could be combined with those of other regional studies.

Report
OMNR Library

130. Jobes, A. 1999. Effects of selection cutting on habitat structure and bird communities in the tolerant hardwood forests of Algonquin Provincial Park, Ontario. Trent Univ., ON. H.B.Sc. Thesis. 60 pp.

This study involved testing 3 hypotheses: (1) changes in stand structure through selection cutting are greater than from natural disturbance; (2) these changes in structure are sufficient to change bird communities within managed stands; and (3) these changes in structure will change with time as logged stands regenerate, stimulating corresponding changes in bird communities. Three different types of wildlife habitat structure were studied: logged-recent, logged-old, and unlogged. The songbird community structure appeared to change with the habitat structure. The present method of selection cutting may not be ecologically sustainable in Algonquin Park. In future, more research on the effects of forestry practices on forest communities could sustain populations while maintaining harvest quotas.

Thesis
Trent Univ. Library

131. Johnson, F., Paterson, J., Leeder, G., Mansfield, C., Pinto, F., Watson, S. 1996. Artificial regeneration of Ontario's forests: species and stock selection manual. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 131. 52 pp.

This species and stock selection manual presents an overview of the operational procedures involved in Ontario's artificial regeneration program. It covers 6 main topics: seed considerations, types of nursery stock, selecting nursery stock, ordering seedlings, handling and care of planting stock, and monitoring seedling health.

Report
Ontario Forest Research Institute

132. Johnston, E.F. 1973. Implementation of forest management on private lands. Pp. 13-21 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P 1. 126 pp.

This talk presents an overview of private woodlot management in the region. A case study of woodlot management, including current stand conditions, stand history, prescription, and the results of an unscrupulous timber buyer performing the harvest are presented. Recommendations for improvement of woodlot management are included.

Proceedings
OMNR Library

133. Jones, S.L., Naylor, B.J. 1993. A comparison of small mammal communities in old pine forests and other common forest types in Sault Ste. Marie District. Ont. Min. Nat. Resour., Ont. For. Res. Inst., For. Landscape Ecol. Prog., Sault Ste. Marie, ON. For. Fragment. Biodiv. Proj. Rep. No. 12. 26 pp.

The primary objective of this study was to describe the small mammal communities inhabiting old pine forests, and other forest types common to the area, in order to: (1) identify whether old pine forests represent unique wildlife habitat for small mammals; and (2) predict the effects of timber harvest on small mammal communities of old pine forests. Small mammals were collected in cut and uncut stands of 4 different forest types: old-growth white pine, hard maple, boreal mixedwood, and black spruce. Study results suggest that old pine stands are not unique habitats for small mammals, and that the type of cutting studied does not result in significant changes to the small mammal community.

Report
Ontario Forest Research Institute

134. Kourtz, P. 2002. Red oak prescribed burn expert system. Ont. Min. Nat. Resour., Southcent. Sci. Inf. Sect., North Bay, ON. CD-ROM.

This compact disc contains data and information on prescribed burning in central Ontario hardwood stands. A file titled *Oak Burn Literature Survey* details specific studies across central Ontario where prescribed burns have been conducted. The file titled OrPBX.HLP is a guide and a help file for the Red Oak Prescribed Burn Expert System (OrPBX). This guide describes the problem of regenerating red oak and offers an approach for overcoming some of the challenges. A direct link is provided from this program into a field guide that describes the vegetation and appropriate ecosites, and provides descriptions and photographs of past burns. The OrPBX program helps forest managers define necessary and desired burning conditions, states the likely consequences of the proposed burn on competing vegetation, and assesses the overall chance of success. Also in the OrPBX.HLP file are reports and photos of recent central Ontario red oak prescribed burns, including prescribed burns between 1995 and 2000 at Pigeon Lake, Indian River, Military Trail, Schweigert's Creek, and Park Lake. The file titled OrPBXFUSION.exe is a template available for forest managers to assist in making decisions when conducting studies involving prescribed burning.

CD-ROM
Ontario Forest Research Institute (SSI)

135. Lachance, D., Hopkin, A., Pendrel, B., Hall, J.P. 1995. Health of sugar maple in Canada:

Results from the North American Maple Project, 1988-1993. Nat. Resour. Can., Can. For. Serv., Ottawa, ON. Ont. Inf. Rep. ST-X-10. 27 pp.

The North American Sugar Maple Project (NAMP) is a joint project of the Canadian Forest Service, Natural Resources Canada, and the United States Department of Agriculture Forest Service, initiated in 1988 with the goal of monitoring changes in crown condition of sugar maple. The project includes 233 sites throughout the range of sugar maple in eastern North America. This report describes the condition of sugar maple for the 62 sites in Canada from 1988 to 1993, half of the trees were in sugar bushes (stands managed for sap production) and half in stands not managed as sugar bushes. In general, the condition of sugar maple crowns improved between 1988 and 1993, particularly in Quebec, which had the highest level of crown dieback in 1988. In Ontario, trees were affected by drought and defoliation by insects. Trees in New Brunswick and Nova Scotia remained in good condition. Differences in crown condition were small between stands managed for sap production and non-sugar bushes, and between sites with different levels of wet acidic sulfate and nitrate precipitation. Dieback and transparency levels increased with increasing tree diameter. Tree mortality was higher in the intermediate/suppressed crown classes than in the dominant/codominant classes, and was higher in the larger diameter classes. Mortality did not differ between sugar bush and non-sugar bush stands. Trees with high initial levels of dieback showed a greater tendency to decline further than those with low levels of damage. The rate of taphole closure was significantly reduced as dieback levels increased.

Report
OMNR Library

136. LaRocque, G. 1985. Regeneration in a tolerant hardwood stand managed under single-tree selection. Can. For. Serv, Petawawa Nat. For. Inst., Petawawa, ON. Inf. Rep. PI-X-50. 16 pp.

A regeneration survey was made in a tolerant hardwood stand managed by single-tree selection. Regeneration was assessed to determine whether different treatments within the single tree selection method (residual volume:140 and 210 $m^3$/ha, maximum diameter: 40 and 50 cm, cutting cycle: 5 and 10 years) affect seedling density and distribution. Analysis showed that treatment interactions are more important than each individually. The highest number of seedlings in the established group can be obtained with the following combination of treatments: residual volume of 140 $m^3$/ha, maximum diameter of 40 cm, and cutting cycle of 5 years. Furthermore, the distribution of seedlings was influenced only by the residual volume treatment, and best percentages were obtained with 140 $m^3$/ha. Regeneration is composed mainly of sugar maple; beech, red maple, and basswood are found at lower densities. Ten other species were found, but were sparsely distributed.

Report
OMNR Library

137. Larsson, H.C. 1962. A compendium on chemical thinning and release studies by basal treatments on some common hardwood species of southwestern Ontario. Ont. Dept. Lands For., Res. Br., Maple, ON. File Rep. 63 pp.

The objective of this study was to determine whether chemical removal of inferior trees and shrubs would be an appropriate way to improve high-graded woodlots.

Report
Ontario Forest Research Institute

138. Larsson, H.C. 1965. Importance of hardwoods in southwestern Ontario. Ont. Dept. Lands For., Res. Br., Maple, ON. File Rep. 19 pp.

This report demonstrates the economic importance of hardwoods in the

southwestern region by defining the acreage of productive forest land, its physical potential, diversity of species, allowable cut, actual cut, stumpage and estimated value by species, as well as the wholesale value by species of lumber sawn at mills in the area.

Report
Ontario Forest Research Institute

139. Larsson, H.C. 1973. Research studies on the uplands and lowlands of southern Ontario. Pp. 22-30 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

Practical techniques for the selection, mass production, establishment and management of superior trees on a variety of sites are being developed.

Proceedings
OMNR Library

140. Larsson, H.C. 1978. Hardwood tree improvement program of the southern silvicultural research unit. Pp. 93-97 *in* Yeatman, C.W. (ed.) Proc. 16th Meeting of the Canadian Tree Improvement Association, Part 1: minutes and members' reports. Univ. Man., Winnipeg, MN. Can. For. Serv. 243 pp.

The objectives of the tree improvement program being conducted in southern Ontario by the Ontario Ministry of Natural Resources (OMNR) Southern Silvicultural Research Branch are to develop practical techniques for the selection, mass production, establishment and management of superior trees and shrubs on lowland sites to help meet the OMNR forestry, agricultural, wildlife and environmental needs.

Proceedings
OMNR Library

141. Larsson, H.C., Jaciw, P. 1959. Hard maple thinning studies. Ont. Dept. Lands For., Res. Div., Maple, ON. File Rep. No. 7. 5 pp.

A thinning study was established to investigate the possibilities of improving the growth and quality of hard maple in farm woodlots.

Report
Ontario Forest Research Institute

142. Larsson, H.C., Jaciw, P. 1959. Plantation studies: (1) Spacing and pruning of white pine, red pine and white spruce, and (2) Establishment of hardwoods and conifers in plantations at East Gwillimbury. Ont. Dept. Lands For., Res. Div., Maple, ON. File Rep. No. 3. 11 pp.

One of the principal problems of forestry in southern Ontario is the establishment of plantations on submarginal land. A planting experiment was carried out to study the following aspects: species to be planted, method of planting, spacing of seedlings and cultural treatments for production of quality material.

Report
Ontario Forest Research Institute

143. Larsson, H.C., Jaciw, P., Roos, O. 1964. The effects of some ecological and silvicultural conditions on seasonal diameter growth as measured with dendrometer tapes. Ont. Dept. Lands For., Res. Br., Maple, ON. Res. Rep. No. 56. 40 pp.

A total of 870 dendrometer bands were used to measure the effects of silvicultural treatments and ecological factors at bi-monthly intervals from 1958 to 1962 on trees in a hard maple stand, a silver maple woodlot and a red pine plantation.

Report
OMNR Library

144. Latimer, R.B., Skeates, D.A. 1982. Seed storage in Ontario. Pp. 6-12 *in* Proc. IUFRO Int. Symp. Forest Tree Seed Storage, Sept. 23-27, 1980, Petawawa Nat. For. Inst., Petawawa, ON.

The Ontario Tree Seed Plant was established in 1922 to maintain a supply of seed for a 1-million-tree planting program. Changes in storage conditions and magnitude of program are described. Currently 75 species are maintained in frozen storage at -3° C to support the provincial reforestation

program, including forest re-establishment, ornamentals and species required for wildlife habitat management.

Report
Ontario Forest Research Institute

145. Leech, R.H., Kim, Y.T. 1990. Methods to investigate fertilization as a means to improve growth and yield of sugar maple. Soil Sci. Plant Anal. 21: 2029-2051.

NPKCa fertilizers were applied annually for 5 years to a mature sugar maple woodlot in southern Ontario. Effects of fertilizer treatments on sugar yield were shown to be significant when the area of crown overlap of competing trees was subtracted from the crown area of crop trees. Sap analysis showed significant relations between sap nutrients and diameter growth.

Journal paper
OMNR Library

146. Lefebvre, J.L. 1982. Site index comparisons among several northern hardwood tree species in eastern Ontario. Lakehead Univ., For. Dept., Thunder Bay, ON. B.Sc.F. Thesis. 46 pp.

This study occurred in Stormont, Dundas, and Glengarry Counties in eastern Ontario. Five northern hardwood species were compared using a site index comparison graph. A regression of site index of one species on the site index of a paired species was performed. Then site index ratios between species were calculated, and trend lines were determined. The results of this study were compared to Carmean's for northern Wisconsin and upper Michigan. Carmean's site index comparison graphs and equations produce reliable estimates of site index for northern hardwood species in eastern Ontario.

Thesis
Lakehead Univ. Library

147. Leslie, A.P. 1931. Report on the forest regeneration survey of cutover pine lands unburned since logging, Algonquin Park, Ontario. Ont. Dept. Lands For., Ont. For. Br., Toronto, ON. 69 p.

In Algonquin Park during the summer of 1931 a survey was conducted of regeneration of white pine on cut-over lands unburned since logging. This work supplements the program carried out in the North Bay district during the summer of 1930 and introduces some new aspects of pine regeneration following cutting. The reasons for such a survey were to determine the conditions of the forest after removal of the pine trees; to estimate the number of pine and spruce regenerating in the present stand; to find the relationship between recruitment before and after logging; and to study the factors influencing the establishment and survival of seedlings.

Report
Ontario Forest Research Institute

148. Leslie, A.P. 1967. Summary statement of research, diagram of location of research stations across the province and sketch of the Maple station. Ont. Dept. Lands For., Res. Br., Maple, ON. File Rep. No. 176. 9 pp.

A summary of research by the Research Branch of the Ontario Department of Lands and Forests is presented with a map of station locations.

Report
Ontario Forest Research Institute

149. Lewis, W., Boysen, E.P., Mackenzie, J., Woods, M.E., Miller, R.J., Zakrzewski, V., Hayden, J., Matuszyk, J. 1994. Ontario's Growth and Yield Program: 1993-1994 annual report. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 22 pp.

This report details the accomplishments of each of the 4 Ontario regional growth and yield programs (field aspect) and that of the Ontario Forest Research Institute (planning, data analysis, and modelling aspects) for the period April 1993 to March 1994.

Report
Ontario Forest Research Institute

150. Logan, K.T. 1965. Growth of tree seedlings as affected by light intensity. Can. Dept. For., Ottawa, ON. Publ. No. 1121. 12 pp.

This experiment involves growing white birch, sugar maple, and silver maple for 5 years in 13, 25, 45, and 100% of full light. Information on height, leaf dimensions, oven dry weight of roots, shoots, and foliage are recorded and interpreted. The behaviour of the different species in response to light intensity is also evaluated. Silver maple, yellow birch, and white birch appear to prefer areas of 45% light; those with more light do not grow as tall. Sugar maple adapts to a range of light treatments, however, maximum height growth occurs between 13 to 45% of full light. When yellow birch seedlings are grown in 25 and 13% light, their roots are significantly smaller than those of the sugar maple. Future studies could involve determining why these differences exist and if differences in leaf morphology could be a contributing factor.

Report
Ontario Forest Research Institute (SSI)

151. Love, D.V., Beckwith, A.E., Morawski, Z.L.R. 1972. Studies of land productivity for hardwoods in southern Ontario. Canada Land Inventory Program, ARDA, Toronto, ON. Rep. No. 6. 139 pp.

These studies were undertaken with a view to providing and interpreting some basic information related to the yields of hardwoods and the economics of hardwood production in southern Ontario. Most of the information collected relates to the area in Ontario south of the Canadian Shield. With the exception of a small area in the ownership of counties and conservation authorities, most of the forest land in this region is privately owned. As such, it has been managed under limited regulation and is now producing at far less than its potential with respect to both volume and quality.

Report
OMNR Library

152. Mach, C. 2000. Case Study: Dufferin County oak prescribed burn. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

The effect of repeated prescribed burning combined with overstorey cutting on the regeneration of red oak in southern Ontario is presented. A background on the history of the Dufferin forest, history of the project, and a description of the site is provided. The objectives of the burn were to reduce/eliminate leaf litter and duff layer to allow acorn germination, and to kill competing shrub and tree species. Both of the burns were effective in reducing the duff/litter layer and killing the competing vegetation. Poplar invaded the site and sugar maple sprouts were competing with the oak sprouts. Future treatments could possibly be supplemental planting of acorns and/or seedlings, and the use of mechanical and/or chemical means to reduce the competing species.

Proceedings
Ontario Forest Research Institute (SSI)

153. Mallik, A.U., Peterson, G.W., Bell, F.W. 1996. Vegetative seedling regeneration of pin cherry (*Prunus pensylvanica*): Efficacy of herbicide treatment. Nat. Resour. Can., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. NODA Note No. 21. 4 pp.

The objectives of this study were to document seedling recruitment, seed production and soil seed banking of pin cherry and evaluate the efficacy of Vision herbicide to control this competitor. Pin cherry regenerates primarily vegetatively. Vision controls vegetative reproduction but after herbicide treatment, pin cherry will regenerate through seedlings.

Report
Canadian Forest Service Library

154. Martin, P.R. 1994. Effects of forest management practices and forest cutting history on the songbird communities of mature hardwood forest stands, Lake Opinicon, Leeds/Frontenac Cos., Ontario. East. Ont. Model For., Kemptville, ON. Inf. Rep. No. 28. 190 pp.

The objective of this study was to determine the effects of forest management practices on the songbird community in the Eastern Ontario Model Forest. Emphasis was on the mature hardwood forest stand in the area of Lake Opinicon. Vertical structure, tree species diversity, tree density, ground cover, and landscape all influence habitat use by songbirds. A variety of different moderate management techniques that provide large continuous tracts of forested wildlife habitat is the best way to manage forest songbird populations. Fragmentation of habitat affects many songbirds. Replanting efforts were examined and no significant results were found relating bird species diversity to vegetation characteristics of forest/plantation plots. Future studies could examine the ability of habitats to sustain populations of songbirds and investigate reforestation and management of plantations for songbird habitat.

Report
OMNR Library

155. Matson, B. 1990 Living a sheltered life. (Fast Growing Forests Group), Ont. Min. Nat. Resour., FGF Online, Brockville, ON.

This article discusses the history and benefits of tree shelters. The benefits include increased growth with higher relative humidity, increased temperatures, protection from wind, and protection from wildlife damage. When tree shelters are used, the time required to grow trees may also be shortened, and the need to use herbicides reduced. However, tree shelters are expensive because they require intensive site management. Presently, tree shelters are being implemented in studies across southern Ontario.

Report
Ontario Forest Research Institute (SSI)

156. Matuszyk, J. 1996. Ontario Forest Research Institute trial/plot register. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. Unpubl. Rep. 31 pp.

This is a register of research plots and trials that have been established across the province by the Ontario Forest Research Institute. Its purpose is to help field staff carry out their duties with minimal disruption to field research.

Report
Ontario Forest Research Institute

157. McEwen, J.G.K., Burton, D.H., Sinclair, G.A. 1958. A description and evaluation of cultural treatments in the tolerant hardwoods stands of the Lindsay district. Ont. Dept. Lands For., Maple, ON. For. Sect. Rep. No. 19. 13 pp.

This report describes and evaluates scarification as a silvicultural treatment to create favorable conditions for the germination and growth of yellow birch.

Report
OMNR Library

158. McIlveen, W.D., Rutherford, S.T., Linzon, S.N. 1986. A historical perspective of sugar maple decline within Ontario and outside of Ontario. Ont. Min. Environ., Toronto, ON. Air Resour. Br. Rep. ARB-1486-Phyto. 48 pp.

A disorder in sugar maple trees has been identified in North America. Symptoms of the decline include a general recession in health, which eventually causes the trees to die. This disorder has taken on various names such as maple decline, maple decadence, maple deterioration, maple blight, and maple dieback. The causes of the disorder have not been found, however, recently the possibility of acidic deposition or pollutants transported over long distances are believed to be contributing factors. This report summarizes the published data for maple decline and brings a historical perspective to the problem in Ontario and outside the province. The decline affecting sugar maple has been known in North America since the early 1900s. This disease is typically slow-developing and is a non-specific response to defoliation by insects and drought. Other influencing factors such as low soil fertility, soil compaction, or air contaminants cause the trees to be weakened further. Once the trees are weakened, they are

more prone to diseases such as bark beetle attack and root rot.

Report
OMNR Library

159. McLaughlin, D.L. 1985. Summary report of questionnaires distributed to the Ontario Maple Syrup Producers Association. Pp. 445-447 *in* Romanyk, S. 1988. Sugar maple (*Acer saccharum* Marsh.) Canada's national emblem. Ont. Min. Nat. Resour., Toronto, ON. Vol. 1 of 2. 922 pp.

This report summarizes the results of the joint MOE/OMAF Maple Syrup Producers Association surveys, which were initiated by the MOE in 1985. The projects attempted to provide regional background data on forest conditions in Ontario. One project involved establishing a network of permanent observation plots across the hardwood forest region of the province to evaluate the health and growth of trees in these plots. The second project was a questionnaire that was distributed to 610 members of the Ontario Maple Syrup Producers Association (OMSPA). The survey dealt with the technical aspects of the maple syrup industry and the condition of the trees to obtain a consensus about the status of forest decline.

Report
OMNR Library

160. McLaughlin, D.L., Kinch, C., Liljalehto, H., Boysen, E.P. 1996. Hardwood forest health surveys in Ontario - The first 10 years (oral presentation). *In* The Right Stuff for the Future: Proceedings of the Northeastern Forest Soils and the Great Lakes Forest and Soils Conference, July 7-9, 1996, Swan Lake Forest Research Reserve, Algonquin Provincial Park, ON. 87 pp.

Field tour discussion on a province-wide database, containing visual condition of sugar maple forest, used to monitor forest decline in relation to acid rain.

Proceedings
OMNR Library

161. McLaughlin, D.L., Linzon, S.N., Dimma, D.E., McIlveen, W.D. 1985. Sugar maple decline in Ontario. Ont. Min. Environ., Toronto, ON. Air Resour. Br. Rep. ARB-144-85-Phyto. 18 p.

In 1984, the Ontario Ministry of the Environment investigated the role of acidic precipitation in recent maple decline in Muskoka. A field study was designed by the Phytotoxicology Section, Air Resources Branch to examine the etiology of the declining sugar maple trees. Permanent observation plots were established and monitored. The monitoring included obtaining and chemically analyzing soil, twig, and root samples from sugar maple trees that were exhibiting symptoms. Increment cores were collected from sampled trees to examine the chronological growth patterns. Atmospheric acidic deposition rates, forest management practices, the presence of disease, the history of insect defoliation, size disturbance, tree age, site quality and weather records were investigated at each study site location. This report briefly describes the field methodology and presents a summary of the preliminary results. A final report of the 1984 field research study is under preparation and will include greater detail on methods, site descriptions and discussion of all results.

Report
OMNR Library

162. McLean, H.D. 1990. The effect of corn row width and orientation on the growth of interplanted hardwood seedlings. Univ. Guelph, Land Resour. Sci. Dept., Guelph, ON. M.Sc. Thesis. 52 pp.

This study occurred at the University of Guelph Agroforestry Research Station. Corn row width and orientation on the growth of interplanted black walnut and red oak seedlings were investigated. The experimental design was split-plot, with 4 replications, 4 row orientations, and 2 row widths. Shoot growth analyses indicated that the ordering of the orientation treatments from most to least favourable was: NW-SE, NS, EW and NE-SW. More regrowth occured in the NW-SE and NS row treatments than the NE-SW

orientation treatment. Seedling carbon assimilation and light penetration were also assessed in this study.

Thesis
Univ. Guelph Library

163. McLean, M.M. *Undated.* Stand growth and development after partial cutting in tolerant hardwoods. Dorset, Ont. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. File Rep. 9 pp.

In undertaking a partial cut in the tolerant hardwood forest, it is advantageous to consider how the residual stand will develop and grow. The growth in volume and value, and the development of new stand structure, are of great importance in assessing results and in modifying treatment prescriptions or follow-up measures. The material presented is a synthesis derived from: stand tables obtained in Algonquin Park, diameter increment of crop trees, the relationship between diameter growth and stocking, lumber recovery data related to tree grades, and wholesale lumber prices. A direct relationship exists between diameter growth of crop trees and the square root of the total basal areas of competing trees. A curvilinear relationship exists between diameter growth and basal area of competition.

Report
Ontario Forest Research Institute (SSI)

164. McLean, M.M. 1960. Some relationships between growth and quality of sugar maple saplings. Ont. Dept. Lands For., Res. Br., Dorset, ON. File Rep. 20 pp.

Studies conducted on small sugar maple saplings indicate that the incidence and development of mineral stain and rot are associated with slow diameter growth. Conversely, stems exhibiting faster diameter growth tend to maintain relative freedom from these defects.

Report
Ontario Forest Research Institute

165. McLean, M.M. 1964. A management trial in tolerant hardwoods. Ont. Dept. Lands For., Res. Br., Dorset, ON. File Rep. 3 pp.

This is a proposal to study and demonstrate, on a pilot scale, the continuous production of high-quality hardwoods in the south central region. It is intended to serve as a management guide in subsequent work by providing a measure of the effectiveness of the silviculture undertaken, by describing the ecological features associated with production, and by showing the influence of economic factors in the management process.

Report
Ontario Forest Research Institute

166. McLean, M.M. 1986. Selection cutting trials. *In* Tour: Swan Lake Forest Research Reserve, OTHBI scientific review. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. 40 pp.

This site demonstrates changes that can be expected after partial cutting in uneven-aged hardwoods. Log-length skidding occurred on this site and various plots were marked to retain the best growing stock. The data gathered from this study can be used as benchmark growth figures to compare with other similar studies. A growth model devised by Dr. Frank Raymond shows a comparison between actual development and projected development. The author provides an example of stocking development for various periods after treatment.

Proceedings
Ontario Forest Research Institute (And.)(SSI)

167. McLean, M.M. 1987. Stand growth after thinning 61- to 80-year age-class in tolerant hardwoods. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biomass Inst., Maple, ON.

Report
Ontario Forest Research Institute (And.)(SSI)

168. McPherson, S., Strobl, S., Spence, R. 2002. Efficacy of the EZJECT lance for releasing red oak from sugar maple competition. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Note No. 61. 4 pp.

Sugar maple often dominates regeneration in hardwood forests, causing less shade tolerant trees such as red oak to be excluded. The EZJECT capsule injection system, a chemical control method that uses glyphosate herbicide in minimal amounts, was used to release red oak seedlings. Three years after treatment with the EZJECT capsule injection system, substantial crown dieback was apparent in the sugar maple stems. Late fall treatments were found to be most effective when sugar maple DBH was less than 10 cm; i.e., sufficient crown dieback and mortality occurred. This provides a growth advantage to the red oak.

Report
Ontario Forest Research Institute

169. Merchant, B.G. 1988. The effect of soil-site factors on the growth of sugar maple (*Acer saccharum* Marsh.) in the Algonquin region of central Ontario. Univ. Guelph, Dept. Environ. Biol., Guelph, ON. M.Sc. Thesis. 121 pp.

This study occurred in the Algonquin Region of central Ontario. The focus is to investigate the effects of site quality and stand history on stand growth of sugar maple. A method of site classification based on soil and site factors of the region is also developed. Estimates of average annual increase of the stand basal area over several years is used to identify site quality for sugar maple. A survey of 64 study plots indicates that the site quality is underestimated in excessively cut stands. As a result of the low growth rates, stands have small or few trees. Multiple linear regression analysis indicates that the Sherborne sites would have the best returns for management investment in the future. The distribution and availability of soil moisture, along with aspect, controls site productivity. Soil nitrogen is not proportional to maple growth, however, foliar nitrogen levels reflect the site quality. Overcutting is the most limiting effect of history on stand growth. In the future, an estimate of site quality to reflect the quality of trees would be more beneficial than one that measures the quantity of wood produced.

Thesis
Univ. Guelph Library

170. Morgenstern, E.K. 1982. Interactions between genotype, site and silvicultural treatment. Can. Dept. Environ., Can. For. Serv., Petawawa Nat. For. Inst., Petawawa, ON. Inf. Rep. P1-X-14. 14 pp.

The impact of interactions on silvicultural and breeding programs is the objective of this paper, which includes the species *Quercus rubra*. Individual tree characters or traits that have economic importance are the main focus, not statistical problems. Advantages of factorial experiments to analyze the genotype x environment interaction are pointed out. The following factors underlie many of the interactions: climatic differences, soil variations, and genetic buffering. More interactions will probably be interpretable once geneticists study environments and their interactions in more detail.

Report
Ontario Forest Research Institute (SSI)

171. Morneault, A.E. 2000. BRMC repeated burn oak trials. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

This study examines the effects of consecutive prescribed burns on the sprouting capacity, survival, and growth of red oak regeneration, and the development of other woody vegetation. The sample design involved 4 randomized treatment blocks, with 4-10 $m^2$ circular sample subplots per treatment plot. In each treatment, 96 red oak seedlings per treatment were numbered and pinned. Half of the seedlings were 1 to 2 years old and the remaining ranged from 3 to 10 years old. Survival and growth rates were recorded before the burns and after the treatments were completed. Older seedlings are able to survive repeated burning better than young seedlings. In areas where prescribed fire has

occurred with natural regeneration, 3 years should elapse before multiple burn treatments are conducted. After an area has been burned, and overstorey crown thinning has occurred, red oak is the preferred type of regeneration. Burning reduces the height of existing vegetation. At this point, crown thinning to increase light, and the intervention of another burn or selective control tending will encourage red oak regeneration even further. The 3-burn treatment method appeared to be ineffective. Treatment recommendations are provided based on slope positions.

Proceedings
Ontario Forest Research Institute (SSI)

172. Morneault, A.E., Bell, F.W., Pitt, D.G. 1998. Improving the effectiveness of motor-manual and mechanical cutting. *In* Pitt, D.G. and Bell, F.W. (eds.) Third International Conference on Forest Vegetation Management: In-Conference Tour Guide, Aug. 24-28, 1998, Sault Ste. Marie, Ont. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 141A. 140 pp.

Evidence from research studies and operational treatments suggest that the effectiveness of motor-manual cutting can be improved through an understanding of the autecology of target species and modification of cutting operations to minimize sprouting of dogwood, aspen, alder, ash, birch, cherry, and maple. Demonstration plots illustrate this marriage of autecological principles and operational practice to maximize efficacy. Operational experience suggests that carbohydrate reserves in aspen stem and root systems fall steadily after leaf flush, through to the end of the growing season, as carbohydrates are used for tissue production in zones of active growth. The best way to minimize regrowth was to cut basal sprouting species (e.g., alder) below 10 cm and cut root-suckering species (e.g., aspen) above 50 cm during the growing season. To maximize regrowth, cut basal sprouting species above 10 cm, and root-suckering species below 25 cm during the dormant season.

Report
Ontario Forest Research Institute

173. Morrison, I.K. 1984. Effect of crown position on foliar concentrations of 11 elements in *Acer saccharum* and *Betula alleghaniensis* trees on a till soil. Can. J. For. Res. 15: 179-183.

This study took place in a closed forest on a Precambrian-derived till soil in northern Ontario. Whole leaves were collected in August 1981 from specified positions within the crowns of 15 sugar maple and 10 yellow birch trees, and concentrations of N, P, Ca, Mg, S, Fe, Mn, Zn, Cu, and Na were examined. Higher concentrations of K, Ca, Mg, Fe, Zn, and Na were found in lower crown leaves of sugar maple, while higher concentrations of Ca were found in the lower crown leaves of yellow birch. There were no significant differences associated with crown position for other elements. Element concentrations were higher at all crown positions in intermediate as opposed to codominant trees, however, these differences were not significant or were weakly significant. Variation between trees was less in mid and lower crown as opposed to upper crown foliage. Approximately 30 trees per stand should be sampled for both species to bring standard errors to within 10% of the group mean (if analyses are restricted to N, P, K, Ca, and Mg). Forty to 70 trees should be sampled if trace elements such as Mn are to be assessed.

Journal paper
OMNR Library

174. Morrison, I.K. 1990. Addition of organic matter and elements to the forest floor of an old-growth *Acer saccharum* forest in the annual litter fall. Can. J. For. Res. 21: 462-468.

The aim of this experiment was to analyze litter fall and to measure the content of N, P, K, Ca, Mg, S, Fe, Mn, Zn, and Cu over a 5-year period in an old-growth sugar maple stand. The site was located on a till in Norberg Township, Algoma District, Ontario. During the study, the total litter fall averaged 3730 kg/ha/year (dry weight). The highest element (kg/ha) depositions were N (40.6), Ca (37.6)

and K (9.1). The lowest element depositions included Zn (0.28) and Fe (0.57). The turnover time for the forest floor was estimated as 7.4 years. Elements with the longest estimated forest floor storage times included Fe (257.2 yrs), N (18.3 yrs), P (18.3 yrs), and Zn (18.1 yrs). Organic matter had slower cycling of elements as the result of the age of the stand. Just before leaf fall, K, S, P, and N were all conserved to a greater extent by sugar maple trees, while Zn, Ca, and Fe were conserved the least. There was no concern of sugar maple trees being at risk of leaching losses of base cations from the foliage as a result of acidified precipitation.

Journal paper
OMNR Library

175. Morrison, I.K. 1990. Organic matter and mineral distribution in an old-growth *Acer saccharum* forest near the northern limit of its range. Can. J. For. Res. 20: 1332-1342.

This study took place in the Turkey Lakes Watershed in an old-growth sugar maple dominated forest. On 2 sites, the organic matter, along with N, P, K, Ca, Mg, S, Fe, Mn, Zn, and Cu content was compared. Measurements were taken from the following areas: tree-field layer phytomass, the forest floor, and the mineral soil. Both of the stands were in balance with their net phytomass accumulation. Mortality appeared to largely offset growth gains. Growth was significant in these stands, and annual nutrient uptake can still be substantial even if the stand is advanced in age. When similar climatic and stand conditions existed, elements accumulated in the phytomass were proportional to those found in the soil. In terms of phytomass, growth was slightly greater on the higher base site. The higher base site appeared to have more Ca in the phytomass and forest floor than the lower base site due to a more base-rich parent material.

Journal paper
OMNR Library

176. Morrison, I.K., Foster, N.W. 1986. Effects of acid deposition on nutrient cycling in northern hardwood forests. Pp. 139-155 *in* Mroz, G.D., Reed, D.D. (eds.) Proc. The Northern Hardwood Resource: Management and Potential, Aug.18-20, 1986, Houghton, Michigan. Mich. Tech. Univ., Houghton, MI. 434 pp.

This study involved sugar maple and yellow birch stands in the Turkey Lakes Watershed near Sault Ste Marie, Ontario. The focus of the study was to examine the influence of acid precipitation on the ionic composition of through fall, forest floor percolate and mineral soil solution. Two types of podzolic soils were examined, one derived from granitic materials, and the other from a mix of granite and basalt. The soil that had an origin of granite-basalt till contained a higher Ca concentration, was less acidic, and Ca contents of vegetation and litter were higher. The granite basalt till was less acidic and had a higher base saturation than the granitic material. The acidity of precipitation had an annual volume-weighted pH of 4.4, it was reduced by contact with the canopy on both sites and with the forest floor on the Ca-rich site only.

Proceedings
Ontario Forest Research Institute (Cole)

177. Morrison, L.M. 1950. Volume tables for sugar maple and a test of Spurr's formulae. Ont. Dept. Lands For., Res. Div., Maple, ON. Stat. Res. Pap. No. 8. 53 pp.

Two volume tables based on the same set of data (one constructed using harmonized curves, the other using the least squares method) are presented in this report.

Report
Ontario Forest Research Institute

178. Morsink, W.A.G., Jorgensen, E. 1974. Propagation and selection of sugar maple (*Acer saccharum* Marsh.) in Ontario. Ont. Min. Nat. Resour. Toronto, ON. 9 pp.

This report is an attempt at providing the status of the Superior Shade Tree Program for Ontario with regard to the progress made in the propagation and conservation of sugar

maple. This tree species was selected as the prime study object because of its desirability for urban plantings: the apparent lack of a province-wide selection and propagation program, and its obvious Canadian significance. Experiences and results obtained through 6 years of field work with sugar maple with the intent of providing a basis for a continuation of the active development of this type of program for Ontario are summarized. As well, experiences during 1968-1973 are documented. Details regarding the rooting of softwood cuttings under intermittent mist, the methods used for the overwintering of rooted potted cuttings, and the requirements for clonal establishment in the field are explained. The principles used in the selection of material for propagation are outlined, and a list of established clones has been provided along with information on the rooting ability of cuttings taken from a number of potentially valuable selections, which remain to be established as clones.

Report
Ontario Forest Research Institute (SSI)

179. Mutchmor, A.F. 1991. Strategic plan to update and improve the red oak knowledge base at the Ontario Ministry of Natural Resources. Ont. Min. Nat. Resour., Central Ont. For. Technol. Devel. Unit, North Bay, ON. Unpubl. Rep. 27 pp.

This strategic plan identifies the current problems in red oak management and proposes an action plan to address these problems. It can be used to help managers and researchers to focus and coordinate present and future red oak research in Ontario. The objectives of this strategic plan are to: (1) highlight the importance of red oak to Ontario's forests; (2) briefly describe the current status of red oak management and silviculture in Ontario; (3) compile a comprehensive list of current problems and needs of red oak management in Ontario, with a summary of critical needs; (4) propose a problem solving process and action plan for addressing these needs; and (5) make recommendations to improve transfer of red oak knowledge. Other topics covered include an analysis of the current age class distribution of red oak in Ontario, a process and an action plan to address all the critical needs to effectively increase or maintain the component of red oak in hardwood stands, and methods to improve technology transfer of red oak-related knowledge between forestry personnel in Ontario. The report includes suggested readings and a summary of regional red oak trials and operational projects.

Report
Ontario Forest Research Institute (SSI)

180. Mutchmor, A.F. 1993. Strategic plan to address problems and needs of red oak management at the Ontario Ministry of Natural Resources, 2nd draft. Ont. Min. Nat. Resour., Central Ont. Sci. Technol. Devel. Unit, North Bay, ON. Unpubl. Rep. 100 pp.

This strategic plan identifies the current problems in red oak management and proposes an action plan to address these problems. It can be used to help managers and researchers to focus and coordinate present and future red oak research in Ontario. The objectives of this strategic plan are to: (1) highlight the importance of red oak to Ontario's forests; (2) briefly describe the current status of red oak management and silviculture in Ontario; (3) compile a comprehensive list of current problems and needs of red oak management in Ontario, with a summary of critical needs; (4) propose a problem solving process and action plan for addressing these needs, and (5) make recommendations to improve transfer of red oak knowledge. Other topics covered include an analysis of the current age class distribution of red oak in Ontario, a process and an action plan to address all the critical needs to effectively increase or maintain the component of red oak in hardwood stands, and methods to improve technology transfer of red oak-related knowledge between forestry personnel in Ontario. The report includes suggested readings and a summary of regional red oak trials and operational projects.

Report
Ontario Forest Research Institute (SSI)

181. Mutchmor, A.F. 1993. Using prescribed fire to manage red oak and yellow birch in the central region of Ontario. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste Marie, ON. Veg. Manage. Altern. Prog.. (VMAP) Rep. 2(1): 3-6.

Regenerating red oak and yellow birch has been identified as a serious problem in the United States and Canada. Several reasons for the nature of the problem are addressed in this paper. The benefits and methods of prescribed burning and site-specific trials in the Central Region are presented. Researchers are hoping to gain a better understanding of where and when prescribed burning should occur.

Report
Ontario Forest Research Institute (SSI)

182. Mutchmor, A.F. 1994. Photo series: prescribed burn for red oak regeneration, Yuill Lake Area - Bancroft District. Ont. Min. Nat. Resour., Cent. Reg. Sci. Technol. Devel. Unit, North Bay, ON. 84 photographs. 72 pp.

A series of 84 photographs describe the prescribed burn at the Yuill Lake site that occurred on May 10, 1993. A visual representation of the changes in vegetation in permanent sample plots on a burn site over time is provided. Nine plots were randomly located within the proposed burn area on April 29, 1993. At each plot, 4 photographs were taken, 1 facing each cardinal direction. The plot centre was positioned in the centre of each photograph. Around the plot centre, woody vegetation (including at least 1 red oak) was tagged, measured, and photographed. On May 11, June 24, and September 26, the same series of photographs were taken in each plot of pinned trees. This project will continue until 1997, with new photographs being added annually.

Report
Ontario Forest Research Institute (SSI)

183. Mutchmor, A.F. 1994. Strategic plan to address problems and needs of red oak management in Ontario. Ont. Min. Nat. Resour., Central Reg. Sci. Technol. Devel. Unit, North Bay, ON. Unpubl. Rep. 61 pp.

This strategic plan identifies the current problems in red oak management and proposes an action plan to address these problems. It can be used to help managers and researchers to focus and coordinate present and future red oak research in Ontario. The objectives of this strategic plan are to: (1) highlight the importance of red oak to Ontario's forests; (2) briefly describe the current status of red oak management and silviculture in Ontario; (3) compile a comprehensive list of current problems and needs of red oak management in Ontario, with a summary of critical needs; (4) propose a problem solving process and action plan for addressing these needs, and (5) make recommendations to improve transfer of red oak knowledge. Other topics covered include an analysis of the current age class distribution of red oak in Ontario, a process and an action plan to address all the critical needs to effectively increase or maintain the component of red oak in hardwood stands, and methods to improve technology transfer of red oak-related knowledge between forestry personnel in Ontario. The report includes suggested readings and a summary of red oak trials and operational projects in the Southcentral Region.

Report
Ontario Forest Research Institute (SSI)

184. Ondro, W.J. 1973. A comparison of the effects of cutting methods on the growth, yield and structure of northern tolerant hardwoods. Univ. Toronto, Forestry Dept., Toronto, ON. M.Sc.F. Thesis. 105 pp.

This thesis discusses how improvement cuttings can increase productivity and quality in hardwoods. This study occurred in the reserve area for the University of Toronto Forest, near Dorset. Three different types of partial cutting (light improvement, improvement, and commercial) are applied to remove

approximately 20% of the basal area. The cuttings result in different average diameter growths of sugar maple, beech, and yellow birch. A cutting cycle of 8 to12 years is recommended, along with reducing the basal area to 80 $ft^2$/ac (18.4 $m^2$/ha) in trees 4 to 24 inches (10.2 to 60.1 cm) DBH after cutting. If the intensity of cutting is increased, defective, overmature, and poorly formed trees can be removed. This will improve the spacing and increase diameter growth.

Thesis
Univ. Toronto Earth Sci. Library

185. Ontario Department of Lands and Forests. *Undated.* Tolerant hardwoods: silvicultural studies at Swan Lake. Ont. Dept Lands For., Toronto, ON. 10 pp.

During the first 6 years of studies at the Swan Lake Research Reserve, researchers tried to solve regeneration problems of yellow birch. Later research at the reserve focused on silvicultural practices with sugar maple. Research at the reserve covered the following studies: seeding characteristics, seed bed conditions, seedling height growth, effects of associated species, climate, relative humidity, soil temperatures, cutting, thinning, planting, and browse studies. This report illustrates phases of the forest research at Swan Lake.

Report
Ontario Forest Research Institute (SSI)

186. Ontario Department of Lands and Forests. 1965. Forest Research Report, 1944-1964. Ont. Dept Lands For., Res. Br., Toronto, ON. 10 pp.

This report presents an overall picture of the Forestry Section's research program for the past 20 years. The history and objectives of current major research projects in each region are included, as well as the names, titles and locations of current forest research staff. The report has a 1954-1964 Forestry Section bibliography.

187. Ontario Ministry of Natural Resources. *Undated.* George Stroempl's Red Oak Field Work. Ont. Min. Nat. Resour., Maple, ON. 6 pp.

The methodology for several trials for red oak around Bracebridge, Parry Sound, and the Huronia District are described. Recommendations for future experimentation are provided.

Report
Ontario Forest Research Institute (SSI)

188. Ontario Ministry of Natural Resources. *Undated.* Bracebridge tree markers guide: the early years. Ont. Min. Nat. Resour., Bracebridge, ON. 34 pp.

This paper defines the basic forest types and silvicultural techniques being implemented in the Bracebridge District. Methods for assessing individual tree vigour, individual tree quality and risk, common defects, and the tolerant hardwood tree classification system are discussed. A section on marking decisions is included with approaches on how to assess defect and risk, and structural requirements, evaluating regeneration need, and select cut/leave trees. A glossary of terms is also provided.

Report
Ontario Forest Research Institute (SSI)

189. Ontario Ministry of Natural Resources. *Undated.* Comparison of red oak survival and growth. Ont. Min. Nat. Resour., Parry Sound, ON. 7 pp.

Trials for red oak occurred in the Parry Sound District from 1988 to 198[illegible] where stocking of 1-0 versus 2-0 (Tubex and unprotected) seedlings was conducted. Two different types of planting methods were used for this study: open field planting and shelterwood underplanting. Results from this study indicate that the condition of the stock prior to planting is very important. In order for good quality growth response to occur in underplanting shelterwood cuts, the residual basal area should be approximately 11 to 13 $m^2$/ha (50 to 60 $ft^2$/ac). In open fields, spring planting had better results. More efficient sprouting resulted in areas

where deep planting had occurred. Second year growth on trees protected in Tubex was approximately twice that of unprotected trees. In shelterwood areas, browsing is only a problem in open areas (landings, trails, etc.).

Report
Ontario Forest Research Institute (SSI)

190. Ontario Ministry of Natural Resources. 1969. Cull survey tables. Ont. Min. Nat. Resour., Toronto, ON. Timber Ser. Bull. No. 1. 51 pp.

Survey results from 1952 to 1957 of 800 sample plots are presented. The areas in which the surveys took place include the English River, Western Transition, Central Plateau, Superior, Clay Belt, Central Transition, Algoma and Algonquin. Tables show percentages of cull for different tree species which indicate the average annual depletion of volume in standing timber. The tables are used for inventory, management planning, and scaling purposes. (Reprinted as Ontario Ministry of Natural Resources. 1974. Cull survey tables. Ont. Min. Nat. Resour., Timber Ser. Bull. No. 1. 51 pp.)

Report
OMNR Library

191. Ontario Ministry of Natural Resources. 1973. Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., Div. For., For. Manage. Br., Toronto, ON. 84 pp.

This manual was prepared to assist foresters in selecting and managing tolerant hardwood stands in the park. All tolerant hardwood stands in Algonquin Park will be managed under the uniform shelterwood or selection silvicultural systems. The manual will help management foresters to: identify the stands, select the appropriate system, determine marking prescriptions, and instruct field staff in marking procedures. It will be a training manual, or text book, and will be revised based on field experience. The guide contains a section on hardwood defects, including photographs in an appendix.

Report
Ontario Forest Research Institute (Cole)

192. Ontario Ministry of Natural Resources. 1979. Oak to pine. Pp. 46-47 *in* Forest Research '78. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. 2 pp.

An admixture of red oak to pine is one method of treating monocultures before regeneration is completed. A series of plantings that have been established in the Huronia District to demonstrate the development of oak under various stand conditions are described. A jack pine stand approximately 50 years old was thinned and underplanted with 4000 red oak 3+0 nursery stock. A 50-year-old red pine stand that had 5 circular openings and 2 rectangular openings was outplanted with 650 red oak 2+0 nursery stock. Both areas had a survival rate of 92% after the third growing season.

Report
Ontario Forest Research Institute (SSI)

193. Ontario Ministry of Natural Resources. 1980. Netting to protect outplanted hardwood stock. P. 36 *in* Forest Research 79. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. 1 pp.

George Stroempl explains how perforated, polypropylene netting is being used in red oak studies to deter animal browsing. A tube that is 8 cm in diameter is cut at lengths and pinned to the ground with wire rods. Higher planting successes are anticipated which should offset the costs of the netting.

Report
Ontario Forest Research Institute (SSI)

194. Ontario Ministry of Natural Resources. 1981. Hardwood stump sprout regeneration. P. 20 *in* Forest Research 80. Ont. Min. Nat. Resour., Ont. For. Res. Cent, Maple, ON.

This summary describes how sprout development was recorded following the cutting of a red oak-white ash-sugar maple-red maple stand in the Huronia District. Sprouting frequency and capacity varied over the range of tree ages and diameters. As tree age and stump diameter increased, sprouting frequency and capacity decreased. Under most conditions, red maple and

white ash sprouts were superior to those of red oak. Factors that influence sprouting include season of cutting, stump height, bark thickness, location of sprouts on the stump, number of sprouts per clump, thinning technique of clumps, and incidence of decay fungi.

Report
Ontario Forest Research Institute (SSI)

195. Ontario Ministry of Natural Resources. 1983. Management of Tolerant Hardwoods in Algonquin Provincial Park. Ont. Min. Nat. Resour., Toronto, ON. 72 pp.

This manual is intended to provide resource managers with information and guidance to assess the tolerant hardwood forest and predict how their management will influence future development of the stands. It includes sections on how to assess the vigour and quality of trees based on crown, bark, and stand characteristics; land types in Algonquin Park and the forests they best support; prescriptions for hard maple recruitment; prescriptions for yellow birch regeneration; suggestions for silvicultural prescription and performance evaluation; and description of habitat, natural regeneration, establishment, and development of sugar maple, yellow birch, American beech, and eastern hemlock.

Books and guides
OMNR Library

196. Ontario Ministry of Natural Resources. 1983. *Untitled*. Pp. 25-26 *in* Drysdale, D.P. Ontario Tree Improvement and Forest Biomass Institute: Forest Research 1981-1982. Ont. Min. Nat. Resour., Toronto, ON. 42 pp.

Rodents eating acorns and the browsing of young trees by wildlife are major causes of red oak regeneration failures. An efficient method for replacing oak involves planting red oak nursery stock, and using pine as a nurse crop. An example of this method is the 34-year-old red pine-red oak plantation in the Huronia District. This report discusses heights, diameters, and bole length of the oak and pine after thinnings in the plantation in the Huronia District. The number of oaks with epicormic branches increased from an average of 19% in 1975 to 81% in 1981. Pruning, crown vigour and exposure of stems to light increased the number of trees with epicormic branches. In future selective thinnings, this stand will likely produce commercial poles. Since this red pine-red oak plantation was successful, a 3-ha experimental planting of the same mixture was established in 1981 in the Huronia District.

Report
Ontario Forest Research Institute

197. Ontario Ministry of Natural Resources. 1986. Prescribed burning outside the boreal forest. Ont. Min. Nat. Resour., Toronto, ON. 18 pp.

On sites that are not suitable for the development of various deciduous species, yellow birch may be a potential crop species. Prescribed burning can be more economical than mechanical scarification and it can benefit yellow birch development. This paper describes a prescribed burn for yellow birch regeneration that was conducted in the Bracebridge District on November 1, 1985. Burning conditions were adequate to achieve the desired results, however, statistical analyses and substantial conclusions were not reached because site preparation was still occurring.

Report
Ontario Forest Research Institute (SSI)

198. Ontario Ministry of Natural Resources. 1988. Proc. Red oak regeneration meeting, Bracebridge District. Nov. 29, 1988. Ont. Min. Nat. Resour., Bracebridge, ON. Unpubl. rep.

The agenda included seed collection, storage, nursery stock planting, planting methods, competition, and experiments. Red oak parent trees will be identified to determine where to collect the best offspring. Several ideas to solve the problem of prolonged acorn storage are described. Experts will be contacted to obtain more knowledge on this subject and the level of experimentation will be defined. The nursery will be contacted to adjust the fertilizing regime for late summer application. Planting techniques will be

monitored to ensure that they are appropriate. While conducting an ongoing experiment of sprayed/unsprayed stock, competition control under different stand conditions and no competition control will be compared. In the spring and fall of 1989 a comparison of tubes versus sowing will occur. In addition to this, experimentation with ANI-PEL tablets and TUBEX shelters will occur. The final page of these notes explains how ANI-PEL tablets and TUBEX shelters function.

Proceedings
Ontario Forest Research Institute (SSI)

199. Ontario Ministry of Natural Resources. 1989. Report on the Mulock operating block. Ont. Min. Nat. Resour., North Bay, ON. 23 pp.

The Mulock operating block (located 27 km northeast of the OMNR North Bay District office) was established in 1954. In this report, reasons for the establishment of the operating block, harvest operations, and the resulting regeneration are explained. The stand consisted of a significant proportion of yellow birch that was mature and overmature. Prior to 1954, the stand had been harvested approximately 3 times for white pine and yellow birch veneer. The operating block was established to promote yellow birch regeneration and to assess 3 silvicultural cutting methods: circular plots, 12 m (30.5 cm) diameter limit, and strip shelterwood. The only extensive application was the strip shelterwood. Most of the harvest cuts were followed by removing residual trees, clear cutting, and scarification. Planting projects using white pine, white spruce, and red spruce also occurred. Even though several questions were being asked and various methods were being implemented, minimal formal assessment was carried out on this project. In areas where strip cutting and scarification occurred, there was very little yellow birch regeneration. This was also true for areas where maple ridges existed. Assessment that was conducted for the conifer planting revealed that red spruce had the best survival rate. An intensive survey should be conducted to examine the quantity and quality of yellow birch regeneration, and this should be correlated to treatment data. Data to collect in a new experiment are listed. Another recommendation was that this information should be incorporated into the Goulais-Batchawana M.U. manual titled *Silvicultural treatment for the regeneration of yellow birch in Ontario.*

Report
Ontario Forest Research Institute (SSI)

200. Ontario Ministry of Natural Resources. 1990. Red oak management - Algonquin Region, stock production mechanics - Midhurst nursery. Ont. Min. Nat. Resour., Midhurst District, Midhurst, ON. Unpubl. Rep.

This report is an excerpt from the proceedings of a conference on *Red Oak Management and Stock Production Mechanics.* Targets, rotations, compartment selections, sowing, growth patterns, tending, and shipping relating to growing red oak in nurseries and plantations are discussed. No statistical analyses are presented.

Report
Ontario Forest Research Institute (SSI)

201. Ontario Ministry of Natural Resources. 1991. Biodiversity and forestry. Fast Growing Forests Group, Ont. Min. Nat. Resour. FGF Online, Brockville, ON. 16 pp.

Nielsen reported that the following biological factors should be considered in biodiversity: (1) diversity is a group property; (2) the elements of biodiversity are continuously changing and evolving - although some species are lost, the renewal process introduces new species; (3) biodiversity is not uniform over the entire earth - both in terms of variation within species and the number of species. Biodiversity is structured, multidimensional and manipulatable; if we change one part of it, other parts will also change. Stands should be managed under different systems in order for diversity to occur. Ethical issues that affect management decisions should also be addressed when managing stands. Foresters need to advance towards being multidimensional generalists; however,

specialists are still required to address defined issues.

Report
Ontario Forest Research Institute (SSI)

202. Ontario Ministry of Natural Resources. 1991. More on new regeneration tools. Fast Growing Forests Group, Ont. Min. Nat. Resour. FGF Online, Brockville, ON. 11 pp.

Eight trials using Tubex tree shelters have been established across Ontario involving the following species: silver maple, red oak, black walnut, and white ash. Tubex trees had consistently better height growth than control trees. However, root collar diameters of the control trees were significantly greater than the Tubex trees. The Tubex sheltered the trees, promoting height rather than diameter growth. Most of the height growth in Tubex trees occurred between May and August. General conclusions were that tree shelters are a good solution to wildlife damage; however, they may not be suitable for species with indeterminate growth rates such a silver maple. Tree shelters make trees susceptible to early frosts and are costly to install. Animal repellent trials are also being conducted to determine the effectiveness of 4 animal repellent products on selected tree species, as well as their relative cost.

Report
Ontario Forest Research Institute (SSI)

203. Ontario Ministry of Natural Resources. 1992. Hardwood Program. Pp. 7-9 *in* Central Region Science and Technology Development Unit: annual report 1991-92. Ont. Min. Nat. Resour., Cent. Ont. For. Technol. Devel. Unit, North Bay, ON. 17 pp.

This report has a section titled *Hardwood Program* that describes work being conducted in the Logging Damage Study and the Algonquin Region Growth Study (ARGS). Other topics of discussion under this heading include red oak management, marking courses, silvicultural demonstration areas, yellow birch field extension, Northeastern Region tolerant hardwood growth and yield study, Vegetation Management Alternatives Program, and the Central Region Growth and Yield Program.

Report
OMNR Library

204. Ontario Ministry of Natural Resources. 1993. Hardwood Program. *In* Central Region Science and Technology Development Unit: annual report 1992-1993. Ont. Min. Nat. Resour., Cent. Ont. Sci. Technol. Devel. Unit, North Bay, ON. 28 pp.

This report has a section titled *Hardwood Program*. Topics of discussion include marking courses, the Logging Damage Study, and the Algonquin Region Growth Study (ARGS). Various trials involving red oak are also mentioned including Red Oak Repeated Burns Trial in Bracebridge; Prescribed Burn for Red Oak Regeneration; and Red Oak Repeated Burns Trial in Lanark County. A section on yellow birch discusses Yellow Birch Field Extension; Yellow Birch Site Preparation Trial; North Bay District Yellow Birch Prescribed Burn Trial; and Rake Trial. An EZJECT-treated hard maple trial and a triclopyr trial are also mentioned.

Report
OMNR Library

205. Ontario Ministry of Natural Resources. 1993. Vegetation Management Alternatives Program. Pp. 15-20 *in* Central Region Science and Technology Development Unit: annual report 1992-93. Ont. Min. Nat. Resour., Cent. Ont. Sci. Technol. Devel. Unit, North Bay, ON. 28 pp.

This report has a section titled *Vegetation Management Alternatives Program* that discusses red oak repeated burns trials in Bracebridge and Carleton Place.

Report
OMNR Library

206. Ontario Ministry of Natural Resources. 1994. Hardwood. Pp. 4-7 *in* Central Region Science and Technology, North Bay: annual report

1993-1994. Ont. Min. Nat. Resour., Cent. Reg. Sci. Technol. Devel. Unit, North Bay, ON. 25 pp.

This report has a section titled *Hardwoods* that describes tree marking courses, along with the Algonquin Region Growth Study (ARGS), and the Logging Damage Study. There is also a section on yellow birch management where the Yellow Birch Site Preparation Trial and a study titled Success of Yellow Birch Regeneration on Raked Versus Non-Site Prepared Areas is discussed. Other items discussed include the Yellow Birch Prescribed Burn Trial, Red Oak Management Strategic Plan, Prescribed Burn for Red Oak Regeneration, Release Trial for Hard Maple Silviculture, Testing glyphosate backflash in EZJECT-treated Hard Maple, and the Downy Birch Provincial Trial.

Report
OMNR Library

207. Ontario Ministry of Natural Resources. 1994. Vegetation Management Alternatives Program. Pp. 10-14 *in* Central Region Science and Technology, North Bay: annual report 1993-1994. Ont. Min. Nat. Resour., Cent. Reg. Sci. Technol. Devel. Unit, North Bay, ON. 25 pp.

This report has a section titled *Vegetation Management Alternatives Program* that discusses the red oak repeated burns trials in Bracebridge and Carleton Place.

Report
OMNR Library

208. Ontario Ministry of Natural Resources. 1995. Hardwood Program. *In* Central Region Science and Technology: annual report 1994-1995. Ont. Min. Nat. Resour., Cent. Reg. Sci. Technol. Devel. Unit, North Bay, ON. 38 pp.

This report has a section titled *Hardwood Program* that describes the following projects: Silvicultural Calibration in Algoma/North Shore Stands, Evaluating Logging Damage in Silvicultural Cutting Operations, Yellow Birch-Early Fall Prescribed Burn Study, Yellow Birch Site Preparation Trial, Red Oak Repeated Burns Study, the Operational Test of Prescribed Fire as a Yellow Birch Site Preparation Method, and the Power Pellet Study. Other headings in this section include Careful Logging Training Package/Support Program, the Algonquin Region Growth Study (ARGS) database analysis, the Basswood Regeneration Trial, ongoing hardwood program projects, Red Oak Mechanical Scarification Trial, and the red oak library.

Report
OMNR Library

209. Ontario Ministry of Natural Resources. 1995. Regenerating yellow birch. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. Video (VHS) Recording, 63 minutes.

This video shows what can be done to retain a yellow birch component in a stand, and describes how 50 years of research led to the development of new techniques. Historical photos and film, interviews, and graphics supplement extensive field footage. Don Burton set up the Swan Lake Forest Research Reserve in 1950 and initiated studies to determine why yellow birch natural regeneration failed after harvesting. He began by observing yellow birch's unique reproduction ecology, which led to experimental logging and site preparation experiments in 1953 and 1960. Harvey Anderson describes how seedling performance was monitored for more than 30 years and how the results of this extended study are being applied to modern silviculture. The elements of proper site selection, seedbed preparation, canopy reduction, seedling protection, and specialized stand tending are covered.

Video Recording
Ontario Forest Research Institute

210. Ontario Ministry of Natural Resources. 1997. Papineau Lake red oak research plots prescribed burn plan. Ont. Min. Nat. Resour., East Fire Region, Bancroft, ON. File Rep. 65 pp.

This unpublished report includes the fire plan and objectives, maps, and the key staff and contacts for the 1997 Papineau Lake prescribed burn.

Report
Ontario Forest Research Institute (Cole)

211. Ontario Ministry of Natural Resources. 1997. Prescribed burn postburn report: Papineau Lake red oak research plots. Ont. Min. Nat. Resour., East Fire Region, Bancroft, ON. File Rep. 38 pp.

This unpublished report includes the fire plan and objectives, observed fire behaviour data, and the key staff involved for the 1997 Papineau Lake prescribed burn.

Report
Ontario Forest Research Institute (Cole)

212. Ontario Ministry of Natural Resources. 1998. A silvicultural guide for the tolerant hardwood forest in Ontario. Ont. Min. Nat. Resour., Toronto, ON. 500 pp.

A Silvicultural Guide for the Tolerant Hardwoods Working Group in Ontario has been the principal source of information related to the management of tolerant hardwood forests in central and southern Ontario. Much of the information provided in that document remains unchanged in this publication. However, since 1990 there have been significant advances in the understanding of, and approaches to, forestry practice. Of particular note are the recent completion of the forest ecosystem classification system for the area, and OMNR's increased focus on ecological sustainability. The tolerant hardwood forest is an aggregate of 3 interrelated working groups currently differentiated by the Forest Resources Inventory as Hard Maple, Yellow Birch, and Other Hardwoods. This guide provides information on the 7 principal species commonly found in these 3 groups: sugar maple, American beech, yellow birch, red oak, white ash, black cherry, and basswood. The guide deals with the management of even-aged and uneven-aged forests that usually have been lightly cut over, often several times. This guide serves as a source of experiential and experimental knowledge, and should be used as an aid to thoughtful professional practice.

Books and guides
OMNR Library

213. Ontario Ministry of Natural Resources. 1999. Papineau Lake Ban 99-01 prescribed burn plan. Ont. Min. Nat. Res., East Fire Region, Bancroft, ON. File Rep. 65 pp.

This unpublished report includes the fire plan and objectives, maps, and the key staff and contacts for the 1999 Papineau Lake red oak regeneration study prescribed burn.

Report
Ontario Forest Research Institute (Cole)

214. Ontario Ministry of Natural Resources. 1999. Prescribed burn postburn report: Buck Lake red oak research plots. Ont. Min. Nat. Resour., Southcentral Fire Region, Pembroke, ON. File Rep. 30 pp.

This unpublished report includes the fire plan and objectives, observed fire behaviour data, and the key staff involved for the 1999 Buck Lake prescribed burn.

Report
Ontario Forest Research Institute (Cole)

215. Ontario Ministry of Natural Resources. 2000. A silvicultural guide to managing southern Ontario forests, Ver 1.1. Ont. Min. Nat. Resour., Toronto, ON. 648 pp.

The information contained in this silvicultural guide applies to the management of forests growing in southern Ontario. Numerous guidelines based on research in southern and central Ontario, the Great Lake States, and the northeastern United States, are presented, along with practical experience in the development and implementation of silvicultural prescriptions in southern Ontario. Descriptions of natural regeneration and growth characteristics of the most important species include information about their distribution, preferred site characteristics, associated forest cover, reproduction and growth to maturity, reaction to competition, factors limiting development, growth, and health, and stand structure and stand dynamics. Recommendations for the management of forest types are provided, along with skills in how to conduct site assessments, and selection of appropriate silvicultural

prescriptions. The guide details regeneration, tending, and thinning procedures for a variety of different forest types, and where applicable, discusses other forest values and their protection. Silvicultural practices that better apply to the ecosites and forest types and regional concerns arising from the high proportion of private land is also addressed.

Books and guides
OMNR Library

216. Ontario Ministry of Natural Resources. 2001. Healthy forests, healthy business. Ottawa Valley Economic Development Office, Ottawa, ON. 30 pp.

The purpose of this publication is to provide factual information about the forests and forest industry of central and eastern Ontario, illustrate the economic contribution of the industry to the regional and provincial economies and to market the new investment opportunities for wood product-related value-added economic development.

Report
OMNR Library

217. Ontario Ministry of Natural Resources. 2001. Using prescribed fire to maintain or restore red oak ecosystems – a literature survey. Southcentral Sci. Inf. Sect., North Bay, ON. CD-ROM.

This comprehensive CD-ROM discusses various case studies in red oak stands ranging from the northeastern United States to central Ontario. Complete bibliographic information is provided for each study including author, publication title, and an abstract. Each study's methodology is described along with fire behaviour, resulting forest condition, general results, and conclusions. In a separate file, linked documents are included (in Corel Photo Paint format).

CD-ROM
Ontario Forest Research Institute (SSI)

218. Ontario Professional Forester's Association. 1985. Report of the Great Lakes-St. Lawrence Forest Management Committee on tolerant hardwood in Ontario: status of management. Ont. Prof. For. Assoc., Toronto, ON. 19 pp.

This report was compiled as part of a 1983-84 review of tolerant hardwood forest management in Ontario by the standing committee on Forest Management for the Great Lakes-St. Lawrence Forest Region. The main reason for the review was to update the Ontario Professional Foresters Association members on the status of Ontario's forest resources. When this report was compiled, 31 practicing foresters were approached for information and a detailed questionnaire was sent to forest managers for their comments.

Report
OMNR Library

219. Parker, W.C. 2000. Growth, physiology and shelterwood management of red oak. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

The history and characteristics of red oak and how shelterwood management applies to this species are presented. Trials near Foymount, Ontario examined the effects of partial cutting on the understorey microclimate and the physiology of red oak and sugar maple seedlings. Light shelterwood cutting increased soil moisture at 5 and 30 cm depths relative to the moderate shelterwood and uncut stand. Light levels at or below the light compensation point were exhibited as shelterwoods increased understorey light levels relative to the uncut stand. Light environment in the light shelterwood improved the environment more than in the moderate shelterwood. Positive shoot growth occurred in the 2 shelterwoods as a result of light levels that were high enough to support positive shoot growth. The ecophysiological characteristics of natural red oak, planted red oak, and sugar maple seedlings were affected by canopy cover. Sugar maple and oak seedlings that grew

beneath the closed canopy of uncut stands had uniformly low net photosynthesis rates. In contrast to this, oak seedlings had a larger photosynthetic response to light levels beneath the shelterwoods than sugar maple seedlings. Overstorey canopy density influenced seedling water relations. In the uncut stand, leaf water potential before sunrise was lower in seedlings in the understorey and soil moisture availability and seedling moisture was reduced by canopy interception of rainfall, relatively large leaf area, and higher root competition. Significant differences were found for leaf water potential at midday among seedlings and canopy treatments. The Papineau Lake trial indicated that oak seedlings grew larger beneath the shelterwood. The planted oak grew taller than the natural oak.

Proceedings
Ontario Forest Research Institute (SSI)

220. Parker, W.C., Dey, D.C. 1998. Ecophysiological response of northern red oak (*Quercus rubra* L.) and sugar maple (*Acer saccharum* Marsh.) seedlings to overstorey density. *In* Mitchell, A., Puttonen, P. (eds.) Frontiers of Forest Biology: Proc. joint meeting of XVth North American Forest Biology Workshop and Western Forest Genetics Association, June 21-26, 1998, Univ. Victoria, Victoria, B.C.

Successional displacement of oak species by sugar maple is a threat to the regeneration of upland oak ecosystems in the eastern United States and Canada. A field experiment to examine the effects of shelterwood overstorey density, timing of overstorey removal, and post-harvest release treatments on natural and artificial regeneration of northern red oak is being conducted in the Great Lakes-St. Lawrence forest region of central Ontario. Fifty-four plots were established in second-growth, oak-dominated hardwood forest and underplanted with 2+0 oak seedlings in 1994. Partial cutting treatments that reduced canopy cover to 70% and 50% were applied to 18 plots the following winter. An additional 18 plots were left uncut. Reduction in overstorey density and percent canopy cover increased photosynthetic photon flux density, air and soil temperature, atmospheric vapour pressure deficit, and soil moisture availability relative to uncut plots. Overstorey density had a significant effect on net photosynthesis, stomatal conductance to water vapour, and mesophyll conductance to $CO_2$ of oak and maple seedlings, with rates of gas exchange increasing with decreased overstorey density. The ecophysiological response of planted and natural oak seedlings to overstorey density differed only slightly.

Proceedings
Ontario Forest Research Institute

221. Parker, W.C., Elliott, K.A., Dey, D.C., Boysen, E.P., Newmaster, S.G. 2001. Managing succession in conifer plantations: converting young red pine (*Pinus resinosa* Ait.) plantations to native forest types by thinning and underplanting. For. Chron. 77(4): 721-734.

White pine, white ash, and red oak were used in this study to determine the effects of thinning on their growth and survival in a young red pine plantation. This study occurred in the Norton Tract of the Durham Regional Forest on the Oak Ridges Moraine. Seedling diameter, height, stem volume were positively correlated with thinning intensity and the size of canopy gaps. Survival was higher for white ash and white pine than for red oak. Succession to a mixed forest stand can be enhanced through thinning and underplanting.

Journal paper
OMNR Library

222. Payandeh, B. 1981. Choosing regression models for biomass prediction equations. For. Chron. 57(5): 229-232.

Commonly used regression models are described and applied using data from yellow birch and sugar maple. The following models were used based on DBH and height: logarithmic regression model, 2 simple nonlinear power functions, and a multiple linear regression. The best fit to observed biomass was obtained using the simple power functions, and the addition of height.

Journal paper
OMNR Library

223. Plonski, W.L. 1981. Normal yield tables (metric) for major species of Ontario. Ont. Min. Nat. Resour., For. Resour. Gr., Toronto, ON. 40 pp.

Normal yield tables for major Ontario forest species were originally published in Imperial units in 1960, as Bulletin No. 2, Silvicultural Series. This publication contains 2 additional tables, one for spruce on Site Class 1a, and the second for red pine plantations that have been moderately thinned. The basic data used in the preparation of the original tables have been supplemented with additional information on growth and converted into metric units of measurements. The yield tables were then recalculated using the revised basic data and the procedure outlined in Report No. 24 of 1956. This edition thus represents a consolidation of revised normal yield data expressed in metric units.

Report
OMNR Library

224. Quinby, P.A. 1988. Vegetation, environment, and disturbance in the upland forested landscape of Algonquin Park, Ontario. Dept. Landscape Ecol., Univ. Toronto, Toronto, ON. Ph.D. Thesis. 52 pp.

Two conflicting models are examined that provide an explanation for the influence of the environment on upland forest vegetation composition in the Great Lakes-St. Lawrence forest region, specifically, the Algonquin uplands. An index is used to quantify fire impact on each sampled stand. The major influence on forest overstorey composition is a fire-soil moisture complex gradient where the 2 influences are inversely related and fire has the greatest impact. Sugar maple appeared to be mainly at the low fire-high moisture end of the gradient, while red oak occurred at an intermediate position along the gradient. Generalist species of trees, shrubs, and herbs, including red maple are successful across a wide range of light and fire intensities.

Thesis
Univ. Toronto Earth Sci. Library

225. Raymond, F.L., McLean, M.M. 1984. Simulation of growth and yield of hard maple. Ont. Min. Nat. Resour., Timber Sales Br., Toronto, ON. 36 pp.

Report
Ontario Forest Research Institute (And.)

226. Rice, J.A. 1993. Swan Lake Forest Research Reserve, Algonquin Provincial Park: study registry. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 19 pp.

The Swan Lake Forest Research Reserve has supported ongoing experiments, trials, and demonstrations in forest ecology for over 40 years. This study registry covers a variety of research work being done at Swan Lake. The registry provides the background and history of the Swan Lake Forest Research Reserve and a descriptive table indicating species, establishment dates, status, and a brief description of all studies.

Report
Ontario Forest Research Institute

227. Rice, J.A. (ed.).1994. Logging damage: the problems and practical solutions. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 117. 70 pp.

A recognized silvicultural system is necessary to ensure that desired management objectives are being used in forest stands. Logging damage occurs through harvesting as a result of soil compaction or rutting, partial cutting silvicultural systems, or wounds to trees in the residual stand. The impact of logging damage is variable and can often ruin a site's integrity. Three papers summarize logging damage, its impacts on hardwood stands, and provide recommendations for lessening damage in central Ontario and New York state. This report equips resource managers with knowledge on the different types of logging damage and methods for its prevention.

Report
Ontario Forest Research Institute

228. Rice, J.A., Woods, M.E., Batchelor, B.D. 1998. SCANSS: silvicultural calibration of Algoma/North Shore stands: a progress report. Ont. Min. Nat. Resour., Southcent. Sci Sect., North Bay, ON. Tech. Rep. No. 103. 22 pp.

This report discusses results from a preliminary study of stand basal area growth in relation to residual stocking levels. SCANSS stands for Silvicultural Calibration of Algoma/North Shore Stands. Further monitoring and analysis will more fully consider stand structure effects. Increment core data was used to estimate individual tree DBH in the year of the most recent cut. All the trees in each plot were measured to estimate post-cut stocking for each plot. The subsequent growth of trees in each plot was approximated. Correlation analysis between the growth response and the various post-cut stocking levels was used to test for the occurrence of an optimum post-cut stocking level. The uniform shelterwood system should be considered where tree quality or site quality are not adequate. Tentative recommendations are: an 18 $m^2$/ha residual BA in trees at least 10 in (25 cm) DBH, which represents the peak of the Algoma/North Shore arch, no more than 1/3 of the BA should be removed at any one harvest, and wildlife values must still be included in the residual stand. Low-end material and the development of smaller diameter classes should occur in the first harvests to improve the stand. As the stands respond with growth in the BA and tree quality, more traditional selection silviculture system approaches should be used.

Report
Ontario Forest Research Institute

229. Roberge, M.R. 1988. Development of a sugar maple-yellow birch stand following various treatments in 1966. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, QC Inf. Rep. LAU-X-82B. 23 pp.

Results of cutting by 8-ac (3.2 ha) groups and 26% thinning indicate that both methods permit regeneration of a sugar maple-yellow birch stand yielding the same return, at least where there is no subsequent release cutting. This report presents an analysis of data collected over a 15-year period in an uneven-aged sugar maple-yellow birch stand managed by 8-ac (3.2 ha) groups. Every 20 years starting in 1966, 20% of the stand area is to be cut by tree groups and the remainder thinned. In the clearings created by patch cutting and elsewhere in the understorey, site preparation, seeding, planting, seedling filling, and release cutting are to be carried out in the fall, in the spring after the cut, or a few years later. Following 26% crown thinning in 1966, a merchantable volume increase of 38 $m^3$/ha was observed and natural mortality decreased noticeably. Abundant natural regeneration has established and developed in the understorey of the thinned stand and in the clearings. The proportion of sugar maple in 1981 was slightly over 60% and nearly the same for the understorey in the thinned stand and the clearings, regardless of whether sites had been prepared or seeded, planted, or filled with yellow birch. The proportion of yellow birch was slightly over 10% and did not vary with treatment.

Report
OMNR Library

230. Romanyk, S. 1988. Sugar maple (*Acer saccharum* Marsh.): Canada's national emblem. Ont. Min. Nat. Resour., Toronto, ON. Vol. 1 of 2. 922 pp.

This report contains a collection of 100 papers on the growth and management of sugar maple. Topics covered include historical importance, physiology/anatomy, damaging agents, and silviculture/management.

Report
OMNR Library

231. Romanyk, S. 1988. Sugar maple (*Acer saccharum* Marsh.): Canada's national emblem. Ont. Min. Nat. Resour. Toronto, ON. Vol. 2 of 2. 909 pp.

This report contains a collection of 60 papers on the growth and management of sugar maple. Topics covered include silviculture/

management, wood utilization, and physical measurements.

Report
OMNR Library

232. Rooney, P.D. 1980. Some effects of high utilization harvesting on silviculture in Ontario's tolerant hardwoods. Dept. For., Lakehead University, Thunder Bay, ON. B.Sc.F Thesis. 26 pp.

This study occurred in 1979 in the North Bay District in Latchford and Pardo Townships. The quantity of slash remaining on a site logged to saw log standards was compared to a site with residual slash from a high utilization cut. The line intercept fuel sampling method was used to estimate the volume of slash on each tolerant hardwood site. Increased utilization improved yield from an area and reduced remaining slash. Less slash is associated with fewer site preparation problems. The preferred method of site preparation is mechanical because it can be conducted despite large pieces of slash. Smaller diameter slash can be broken down, improving soil exposure. Prescribed burning was not recommended for these sites.

Thesis
Lakehead University

233. Sinclair, G.A. 1950. Forestry in Ontario: what is being done to protect your birch trees? The Quarterly 16:16.

Yellow birch is deteriorating at an abnormal rate in Ontario. Cooperation among federal and provincial departments as well as private landowners is needed to deal with the problem.

Report
Ontario Forest Research Institute

234. Sinclair, G.A. 1954. Annual report of the University of Toronto Forest for 1954. Ont. Dept. Lands For., Maple, ON. Ann. Rep. 32 pp.

This report summarizes activities on the University Forest during 1954 by: administration, research, logging operations, and forest management. An outline of the tentative program for the following year is provided.

Report
Ontario Forest Research Institute

235. Sinclair, G.A. 1962. Progress report of prescribed burning in hardwood stands in Ontario 1960. Ont. Dept. Lands For., Res. Br., Maple, ON. For. Sect. Rep. No. 45. 18 pp.

This report, the third in a series, describes the physiographic and biotic site conditions before burning and the climatic conditions, flame intensity and other fire characteristics during the burning of the same area and another study area in the Bruton Township in October 1960.

Report
OMNR Library

236. Sinclair, G.A. 1962. Some observations of the effects of 2,4,5-T basal spray on tree species 1954-1958. Ont. Dept. Lands For., Res. Br., Maple, ON. For. Sect. Rep. 43. 7 pp.

The aim of this study was to determine the effectiveness of the chemical Esteron applied as a basal spray to different tree species in the dormant season to thin selected immature hardwood stands and release chosen crop trees approaching merchantable size.

Report
OMNR Library

237. Sinclair, G.A., Hill, A.W. 1953. Study of the condition of birch in Ontario. Pp. 167-178 *in* Report on the Symposium on Birch Dieback, Mar. 21-22, 1952. Ottawa, ON. Can. Dept. Agric., Sci. Serv., For. Biol. Div., Ottawa, ON. 182 pp.

This paper reports the steps taken to assess the condition of yellow birch and to record the progress of any abnormal deterioration of this species in Ontario.

Report
Ontario Forest Research Institute

238. Sloane, N.H. 1960. An appreciation of prescribed burning as a silvicultural tool in

Ontario. Ont. Dept. Lands For., Res. Br., Maple, ON. For. Res. Inf. Pap. No. 1. 12 pp.

Prescribed burning may be defined as the controlled use of fire to achieve some predetermined objective. Included as possible objectives are improving cattle range and wildlife habitat, and reducing hazardous litter accumulations. Foresters should consider the use of fire as a silvicultural tool in forest management. This report reviews the literature on prescribed burning and assesses its potential as a silvicultural tool in Ontario's forests. The literature published in other countries indicates that any research done here on prescribed burning should be highly successful in providing new silvicultural techniques for forest management in Ontario.

Report
OMNR Library

239. Smith, A.B.T. 1997. An analysis of the changes in the bird communities of four forest habitats in Algonquin Park, Ontario from 1952-53 to 1995-96. Dept. Zool., Univ. Toronto, Toronto, ON. M.Sc. Thesis. 97 pp.

This study involved repeating 7 breeding bird censuses in Algonquin Park, Ontario, to compare bird communities of 1952-53 and 1995-96. Vegetation changes over the 45 years were recorded in 4 of the main forest wildlife habitats. No major changes occurred in the species composition, the structure of the vegetation, or in the neotropical migrant populations. Overall, no significant differences were apparent between the 1952-53 and 1995-96 breeding bird populations

Thesis
Univ. Toronto Earth Sci. Library

240. Stephenson, A.B. 1958. The effect of deer on yellow birch in Biggar Township, Algonquin Park. Ont. Dept. Lands For., Res. Br., Maple, ON. Wildl. File Rep. 50. 14 pp.

In 1956 the Pembroke District initiated a timber management project to establish yellow birch in Biggar Township in Algonquin Park. Since the deer in this area are not controlled by hunting, and deer were reported to be numerous, it was deemed desirable to conduct an investigation to assess the situation. The investigation included both an aerial and ground survey to determine: (1) the distribution of the deer in relation to the scarified area; (2) the deer population in the area; (3) the stand composition and degree of scarification; (4) the production of yellow birch cotyledons on the scarified patches; and (5) the effect of deer browsing on the vegetation. If browsing is heavy during the early seedling stage, the birch may be suppressed sufficiently to allow less preferred shade-tolerant species like sugar maple to seriously compete with the birch and eventually dominate the site. Other browse species in the area were not sufficiently abundant to greatly relieve the potential browsing pressure on yellow birch. Felling several trees int[illegible]ne scarified patches will afford some protection to the birch seedlings. If sheer abundance of this species over a wide area is insufficient to permit enough individuals to develop, then the deer herd must be controlled. Otherwise, our forests cannot yield the best advantage and management procedures will be of little avail.

Report
OMNR Library

241. Stephenson, A.B. 1958. The effect of deer on yellow birch regeneration: progress report for 1956-57. Ont. Dept. Lands For., Res. Br., Maple, ON. Wildl. File Rep. 58. 36 pp.

The main purpose of this study was to provide information on the effects of browsing on yellow birch at various deer population levels in relation to height growth. The experiment took place at the following locations: Swan Lake in Peck Township, Crozier Lake in McClintock Township, and Kennisis Lake in Havelock Township. Tables and charts indicate the percent of woody stems, height class frequencies, and height class distributions. The Swan Lake area contained only 2100 stems/ac (850 stems/ha) of winter browse species compared with 4000 stems/ac (1619 stems/ha) at Crozier Lake. However, browsing was heavier at Swan Lake, yielding 39,000 browse units/ac (15,789 browse

units/ha) as compared with only 9,000 (3644 browse units/ha) at Crozier Lake. This difference in browsing was the result of the difference in winter deer concentrations in the 2 areas. The Swan Lake area averaged 15 deer/mi$^2$ (0.058 deer/ha) as compared with only 1.5 deer/mi$^2$ (0.0058 deer/ha) at Crozier Lake.

Report
OMNR Library

242. Stephenson, A.B. 1960. Browse survey in the Kennisis Lake Experimental Area, H-92. Ont. Dept. Lands For., Res. Br., Maple, ON. Wildl. File Rep. No. 61. 10 pp.

In 1958, the Division of Research undertook a survey to assess the effects of deer and moose on the regeneration of yellow birch in cooperation with the Forestry Branch of the Canada Department of Northern Affairs and National Resources. The survey was carried out in a yellow birch experimental area designated as Project H-92 located near Kennisis Lake in Haliburton County. An abundance of browse for both deer and moose occurred. The 2 most common browse species were sugar maple and raspberry. Yellow birch was also popular. Browsing was found on 57% of the plots containing yellow birch and on 79% of stems. The present level of browsing will do little more than retard height growth; seedlings will grow beyond the reach of deer within 3 to 4 years.

Report
OMNR Library

243. Stiell, W.M. 1974. Proceedings: Canadian Forestry Service hardwoods management workshop, Sept. 24-26, 1974, Petawawa, ON. Can. Dept. Env., Can. For. Serv., For. Mgt. Inst., Ottawa, ON. 255 pp.

This report contains the proceedings from a workshop on hardwood silviculture and management at the Petawawa National Forest Institute. The agenda included a discussion, based on invited statements, on hardwood research and development needs as seen by representatives, a review of the current program, and identification of research priorities and strategies for tackling them. Major problems confronting managers of tolerant hardwoods were also discussed. People problems and needs are as important, if not more so, than economic or technical concerns. These proceedings reproduce verbatim all formally presented statements, but include only summaries of the discussion.

Proceedings
Ontario Forest Research Institute (SSI)

244. Stout, S., Nowak, C.A., de Calesta, D.S., Schuler, T.M., Jones, S.B., McGill, D.W. 1994. Hardwood crop planning relative density guidelines for eastern Ontario hardwood stands. East. Ont. Model For., Kemptville, ON. Inf. Rep. No. 12. 45 pp.

The focus of this study was to adapt a forest management decision model/simulator for timber production and wildlife habitat maintenance. Three products were called for: a review of the report titled *Review and comparison of stand modelling techniques* by Williams (1994 unpublished), a description of procedures to be followed to develop relative density or stocking guidelines appropriate to Eastern Ontario Model Forests (EOMF), and an annotated bibliography of existing literature about the effects of relative density and changes in relative density on wildlife habitat, wildlife diversity, and timber production. Two additional products were also provided per the request of the EOMF program: (1) a report about the utility of relative density measures in the management of uneven-aged stands or even-aged stands being managed to achieve uneven-aged conditions; and (2) suggestions about how to develop a stand-level decision support system for Eastern Ontario Model Forests.

Report
OMNR Library

245. Streit, M. 2000. Case study: Lanark area oak management. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

This presentation focuses on managing for red oak natural regeneration on high competition sites. There is a relationship between oak regeneration effort, timber quality, and site moisture. Necessary light conditions for resprouting and later development are discussed. Three examples of forests are provided: mature red oak-dominated forest with sugar maple understorey, maple-dominated forests with a minor component of red oak, and red oak/white pine-dominated forest. For each forest type, objectives for the trial and the type of harvest are outlined, along with recommendations for cutting, regeneration, tending, and prescribed burning.

Proceedings
Ontario Forest Research Institute (SSI)

246. Strobl, S., Wagner, R.G. 1996. Early results with translucent tree shelters in southern Ontario. Pp. 13-18 *in* Brissettte, J.C. (ed.) Proc. Tree Shelter Conference, June 20-22, 1995, Harrisburg, PA. USDA For. Serv., Northeast For. Exp. Stn., Gen. Tech. Rep. NE-221. 80 pp.

Growth and survival of red oak seedlings with several types of translucent tree shelters are being compared at 5 old-field sites in southern Ontario. Height of Tubex-sheltered red oak is still greater ($p=0.0021$) than that for unsheltered trees after 5 years. The Quill shelter is not recommended. Third-year red oak height was significantly smaller ($p=0.0001$) than that for either a mesh shelter or no shelter. Survival was not different between sheltered and unsheltered seedlings. It is too early to determine whether tree shelters can reduce the need for vegetation control.

Proceedings
OMNR Library

247. Stroempl, G. *Undated.* Regenerating red oak under deer competition. Ont. Min. Nat. Resour., Maple, ON. Unpubl. Rep. 2 pp.

This booklet provides important information on how to improve the management of red oak stands. Topics covered include regenerating red oak when there is deer competition and planting acorns in tubes.

Report
Ontario Forest Research Institute (SSI)

248. Stroempl, G. *Undated.* Soil-root system relationships in red oak. Ont. Min. Nat. Resour., Maple, ON. Unpubl. rep. 2 pp.

This booklet discusses the types of soils that oaks prefer to grow in, along with a description of the tap root. Tap roots are deeper in lighter soils, and older oaks eventually lose their tap roots. Diagrams are provided which show daily shoot and root growth increments from March to October.

Report
Ontario Forest Research Institute (SSI)

249. Stroempl, G. 1971. Planting of basswood is successful in hardwood cutovers. Tree Plant. Notes 22(1): 26-29.

Basswood is capable of producing high quality sawlogs over a shorter rotation than many other tolerant hardwoods. On suitable sites the aim is a basswood stand composition of 15% to 25% by volume.

Journal paper
OMNR Library

250. Stroempl, G. 1980. Plastic netting to protect trees from animal damage. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. For. Res. Note. No. 27. 4 pp.

It is important to protect newly planted stock from wildlife damage on plantations. Spraying or painting trees works as a repellant, however, this application must be repeated annually and does not protect new shoot growth. A study was conducted involving placing plastic Vexar netting around planted red oak in 1978, 1979, and 1980 in the Huronia Forest District in southwestern Ontario. The black netting protected the red oak seedlings from wildlife.

Report
Ontario Forest Research Institute

251. Stroempl, G. 1983. Growth response of basswood and sugar maple to an intermediate cutting. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. Forest Res. Rep. No. 107. 19 pp.

The growth response of basswood and sugar maple to an intermediate cutting at a stand age of 52 years was followed for 12 years in a stand in Herschel Township, Ontario, where both species were represented in the intermediate and dominant canopies. Sugar maple responded positively in diameter and volume growth, but basswood showed no definite increase in growth, partly as a result of crown dieback. However, basswood exceeded sugar maple in clear bole length and log quality. The differential response to this cutting is a reflection of differences in shade tolerance between the intermediate basswood and very shade-tolerant sugar maple. The main silvicultural objective is to apply early stand tending to retain basswood's original height advantage and its high proportion relative to sugar maple throughout the rotation.

Report
Ontario Forest Research Institute

252. Stroempl, G. 1984. Thinning clumps of northern hardwood stump sprouts to produce high quality timber. Ont. Min. Nat. Resour., Ont. For. Res. Cent., Maple, ON. For. Res. Inf. Pap. No. 104. 27 pp.

Timber cutting in hardwoods often results in stump sprouting, sometimes the only means of natural regeneration. The species, age of the trees cut, diameter and height of the stump and the location of sprouts on the stump are the major factors influencing development of high quality sprouts. This information paper summarizes types of sprout development and recommends how to thin clumps of sprouts. Photographs of white ash, basswood, paper birch, red maple, and red oak illustrate practical examples.

Report
Ontario Forest Research Institute

253. Stroempl, G. 1985. Grading northern red oak planting stock. Tree Plant. Notes 36: 15-18.

The focus of this report was to suggest improved grading standards for red oak to be used in field plantings in southern Ontario. Grading criteria are based on the following: root-collar diameter, stem length, stem form, bud number, and roots of large and small 2+0 nursery stock. Better quality stock will improve the performance of red oak plantations in Ontario. A standard practice that will maximize propagation of sources is using acorns from selected local phenotypes.

Journal paper
OMNR Library

254. Stroempl, G. 1986. Conditions of red oak nursery stock as related to outplanting. Pp. 90-92 *in* Proc. Nurserymen's Meeting, June 24-27, 1985, Orono Forest Station. Ont. Min. Nat. Resour. Orono, ON. 110 pp.

Since 1985, red oak nursery stock has been planted across the Algonquin Region where shelterwood and hardwood/pine stand harvests have occurred. This booklet discusses conditions of stock that must be met to maximize the chances of survival and height growth after outplanting in an area. The conditions of stock that must be met include: bud dormancy, root systems, and quality grading.

Proceedings
Ontario Forest Research Institute

255. Stroempl, G. 1987. Growth and quality of red oak planted in a jack pine plantation. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. For. Res. Note. No. 44. 4 pp.

Few successful red oak plantations exist in Ontario. To meet a growing demand for this species, a study is being conducted in the forest districts of the Algonquin and Central Regions in Ontario. Red oak is being underplanted or interplanted in stands that were originally exclusive pine sites. During the past 11 growing seasons, this study has been successful. Slight negative influences on the stand (disease,

pests, wildlife, windthrow etc.) were found. Mechanical scarification had a more serious effect on the growth of sprouts than anticipated. The amount of canopy opening did not affect the survival and early development of the oak. Underplanted oak seedlings did not grow very well until they were released, however, their root systems showed good development. When red oak becomes established, it can be secured by using prescribed burning to control the competing vegetation and activate rapid stump sprouting. After the burn occurs, white pine can be interplanted with the red oak. Jack pine was excellent in preventing soil erosion, and it created good conditions for red oak growth. In similar situations with red or Scots pine, red oak could be introduced directly after the last thinning to ensure that no serious ground competition would occur.

Report
Ontario Forest Research Institute

256. Stroempl, G. 1987. Growth and quality of red oak planted in red pine plantation openings. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. For. Res. Rep. No. 117. 6 pp.

This forest research report summarizes the results of trials to test the survival and potential height growth of red oak nursery stock in the forest districts of the Central and Algonquin Regions. The stock was planted under a variety of stand conditions. Approximately 98% of the red oak nursery stock survived following the planting in openings of a mature red pine plantation. Another 61% of this group produced an average height of 3 m in 10 years and exhibited good stem quality. Planting of red oak as an admixture in stand conversions was recommended.

Report
Ontario Forest Research Institute

257. Stroempl, G. 1987. Hardwood silviculture: thinning coppice growth to produce biomass and timber. J. New For. Silv. 2(2): 20-22.

Basic thinning guidelines for hardwood stands of coppice origin are provided for forest practitioners and woodlot managers.

Journal paper
Ontario Forest Research Institute

258. Stroempl, G. 1989. Collection, storage and germination of red oak acorns. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. Unpubl. rep. 2 pp.

This booklet provides important tips on the identification of parent trees, stages of maturity, size of acorns, and a test to determine whether acorns have insect larvae or fungi. Techniques for storing acorns for a few days or over one winter are also addressed. It is important to have a low, stable temperature when storing acorns, so that later they will germinate. Acorn germination requirements are also presented.

Report
Ontario Forest Research Institute (SSI)

259. Stroempl, G. 1989. Red oak regeneration program in Ontario: an overview of management and research (oral presentation). Presented at 4th Workshop on Seedling Physiology and Growth Problems in Oak Plantings, Mar. 1-2, 1989, Columbus, OH. 4 pp.

Red oak research studies and operational trials are being conducted in the Algonquin Highlands Section and Huron-Ontario Section of the forest region. Few successes occurred with earlier trials involving planning due to poor quality stock, poor practices, and the browsing of animals. The following methods are being used to regenerate red oak: 1) planting bareroot nursery stock; (2) planting (germinated) acorns in Kraft tubes; (3) spot-sowing acorns, and (4) prescribed burning to encourage resprouting. Tree shelters and protective plastic netting are also being investigated to determine if they would reduce acorn requirements and deer browsing, along with controlling competition. The main problems in red oak management appear to be in providing uniformly effective competition control and excluding animal damage.

Report
Ontario Forest Research Institute (SSI)

260. Stroempl, G. 1989. Tips to improve conditions of red oak nursery stock as related to outplanting. Ont. Min. Nat. Resour., Ont. Tree Improv. For. Biom. Inst., Maple, ON. Unpubl. rep. 2 pp.

Since 1985, red oak nursery stock has been planted across the Algonquin Region where shelterwood and hardwood/pine stand harvests have occurred. This booklet discusses stock condition requirements to maximize survival and growth after outplanting. Bud dormancy, root systems, and quality grading are of major concern.

Report
Ontario Forest Research Institute (SSI)

261. Stroempl, G. 1990. Some areas of concern in red oak management and research. Pp. 1-4 *in* Proc. Red Oak Management Seminar, Dec. 18, 1990, Bracebridge, ON.

Seven areas of concern for red oak management are addressed: (1) identify acorn collection areas and intensify acorn collections; (2) increase production of bareroot nursery stock of best quality and encourage planting in the fall; (3) intensify shelterwood cutting and site preparation for underplanting; (4) fund research for direct sowing; (5) fund research for the production and planting of container stock; (6) fund research for propagation and establishment of acorn orchards; and (7) fund research for the protection of transplants.

Proceedings
Ontario Forest Research Institute (SSI)

262. Stroempl, G., Beckwith, A.F. 1978. A successful red oak-red pine plantation. Ont. Min. Nat. Resour., Maple, ON. For. Res. Note No. 173 pp.

A 28-year-old red oak - red pine plantation was investigated which involved the interplanting or underplanting of suitable hardwoods and conifers. The study area was located on Randwick Tract, Dufferin County, Ontario. In 1970, when the oak was 23 years old, it was released to a mixture of 66% pine, 34% oak, for a total of 2070 trees/ha. The oaks, pine and suppressed oaks were thinned and pruned in 1975. Some trees were also cut to satisfy sampling requirements. An analysis of height and diameter of the 2 species revealed that, initially, the pine grew faster than the oak. At 18 years, pine height growth slowed noticeably. However, the oak eventually surpassed the pine at 28 years. In areas with variations in topography and moisture, the timing and intensity of release-thinnings should be closely related to the site features that affect growth.

Report
Ontario Forest Research Institute

263. Stroempl, G., Deugo, D.T., Wright, K., Secker, P.W., Metcalf, H., Schenk, M., Fleck, B. 1989. Red oak regeneration program in Ontario. *In* Forestry Research Marketplace: Results in Action: Proc. Ont. For. Res. Com. Symp., Nov. 21-23, 1989, Toronto, ON. OFRC Symp. Proc. O-P-18. 151 pp.

Poster abstract. The primary factors that must be controlled to ensure establishment of red oak by any regeneration method are vegetative competition and damage caused by animals, primarily browsing by deer. Chemicals are effective for controlling competition, however, establishment will not be secured unless red oak is individually protected where animal damage is the limiting factor.

Proceedings
OMNR Library

264. Stroempl, G., Secker, P.W. 1989. Preliminary guideline for the uniform shelterwood cut. Ont. Min. Nat. Resour., Maple, ON. 9 pp.

A variety of treatments conducted in hardwood stands are listed for a 10-year period with their purposes and results. Steps are provided (including tree marking guidelines) that describe how to prepare a stand for a regeneration cut. Efforts are in progress to plant red oak nursery stock after stand treatments. Certain conditions of the stock such as bud dormancy, root system, and quality grading should be met to maximize the chances of survival and growth after outplanting. Soil groups that oaks prefer to grow in are discussed, along with parent tree and offspring

characteristics. An overview of the management and research into red oak regeneration in Ontario is also provided.

Report
Ontario Forest Research Institute (SSI)

265. Stroempl, G., Secker, P.W. 1995. Guide to the group shelterwood cutting method for regenerating northern red oak. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON, For. Res. Inf. Pap. No. 120. 45 pp.

Shelterwood cutting in the northern hardwood forests of North America is the silvicultural method recommended to regenerate heavy-seeded hardwood species such as northern red oak. The group shelterwood cutting method, applied on a small scale as opposed to using large-scale uniform shelterwood cutting, is particularly attractive because of the smaller risk of failure taken during the critical stages of establishment and early growth of red oak regeneration. This report describes and illustrates a step-by step field procedure for a 3-phase group shelterwood cutting method that can be used to regenerate red oak naturally or artificially. This report also includes practical appendices on soil-site requirements of red oak, tree marking guidelines specific to the group shelterwood cutting method, regenerating red oak in the presence of deer browsing, nursery measures to maximize planting success, and the assessment of planting stock quality and seed tree and offspring characteristics.

Report
Ontario Forest Research Institute

266. Sutton, R.F. 1985. Vegetation management in Canadian forestry. Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-369. 34 pp.

Vegetation management in Canadian forestry is reviewed. The importance of the forest industry to Canada's economy is outlined and the need to intensify forest management if economic benefits are to continue is stressed. Factors governing the choice of method of vegetation control and determining the advantages and disadvantages of each method for the type of control needed are discussed. With respect to herbicides, a distinction is drawn between herbicide efficacy (the capacity of a herbicide to cause direct phytotoxic effects in weeds) and silvicultural efficacy (the capacity of a herbicide indirectly to promote positive growth responses in crop trees). Efficacy is then examined in relation to site preparation, cleaning, and release. The peculiarity of problems of cost-benefit analysis applied to forest vegetation management is emphasized, especially those aspects of such analysis that contrast with those related to agriculture.

Report
OMNR Library

267. Swaile, B. 2000. How to collect and store acorns. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

Techniques for collecting and storing acorns to ensure a supply of high quality, viable seeds are described. Researchers should be aware of the oak family that they are planning to collect. Trees adapt to their environmental surroundings, therefore, the seed zone boundaries should be respected when planting acorns. Factors used in determining which trees to collect from include: phenotype, absence of weevil damage, and crop availability. The best time to collect acorns is when they are physiologically mature between late September to mid-October. When storing oak acorns, it is important to prevent excessive drying. Red oak is best stored with a moisture content above 30% at a temperature of 1 to 3° C. Polyethylene bags can be used to store red oak for long periods.

Proceedings
Ontario Forest Research Institute (SSI)

268. Sykes, J.M. 1964. Report on the interim results of prescribed spring burning in a poor-quality hardwood stand. Ont. Dept. Lands For., Res. Br., Maple, ON. For. Sect. Rep. No. 49. 12 pp.

This experiment was intended to evaluate the feasibility and effectiveness of springtime prescribed burning for eliminating a young hardwood stand composed principally of poor-quality coppice stems.

Report
OMNR Library

269. Taylor, K.M., Aarssen, L.W. 1989. Neighbour effects in mast year seedlings of *Acer saccharum*. Am. J. Bot. 76(4): 546-554.

This study took place on the property of the Queen's University Biology Station at Lake Opinicon in southeastern Ontario. The study objective was to search for evidence of neighbour effects on size variation in 2-year-old sugar maple seedlings that had resulted from masting within a mature population of sugar maple in southeastern Ontario in 1984. A total of 14 sugar maple trees with a DBH greater than 40 cm were randomly selected as sampling sites. Natural regeneration on 185 quadrats was surveyed between 26 June and 26 September 1986. In the first half of the sampling period, negative correlations of mean height with the density of 2-year-old seedlings within quadrats indicated that competition is an important factor affecting seedling size. In the second half of the sampling period, shorter, more suppressed seedlings under higher densities increased their relative height in response to earlier competition. A positive correlation was found in distances between pairs of nearest neighbouring seedlings collected in October 1986. The height of 2-year-old seedlings was unaffected by light intensity, however, seedling density caused the largest percentage of height variation.

Journal paper
OMNR Library

270. Tozer, R., Checko, N. 1996. Algonquin Provincial Park bibliography. The Friends of Algonquin Park, Whitney, ON. Algonquin Park Tech. Bull. No. 12. 116 pp.

This bibliography is a compilation of over 1800 references dealing with Algonquin Park and its resources. Basically we have included all books, theses, scientific papers, internal reports, and magazine articles that in our judgement could be of use to anyone studying Algonquin Park. With the exception of the considerable number of papers based on work done at the Algonquin Radio Observatory, and annual forest insect outbreak reports, we have included all research papers done in Algonquin or based on material collected in the park. When a reference is housed in the Algonquin Park Visitor Centre Library, a reference number appears in the left margin. As an aid in locating references in specific fields we have broken this bibliography into the following categories: amphibians and reptiles, archaeology, birds, fish and limnology, forest management, research and ecology, geology and geography, history, invertebrates and parasites, mammals, park management and recreation, and plants.

Report
Ontario Forest Research Institute (Cole)

271. Turner, M. 2000. Case study: Leslie Frost Centre oak management. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

An examination of the silvicultural treatments used to regenerate red oak at the Leslie M. Frost Natural Resources Centre is presented. The treatments include shelterwood cutting, planting with no tending, planting followed by herbicide application, post-harvest burn, and clearcutting. Red oak regenerates on shallow sites and full sunlight is required for optimum growth of this species. Once red oak reaches a free-to-grow size, it requires release. Competition control is also necessary with this species.

Proceedings
Ontario Forest Research Institute (SSI)

272. Van Wagner, C.E. 1993. Prescribed fire in the Great Lakes-St. Lawrence and deciduous forests of Ontario: problems and potential. Ont. Min. Nat. Resour., Central Ont. Sci. Technol. Devel. Unit, North Bay, ON. Tech. Rep. No. 23 and VMAP Tech. Rep. No. 93-02. 68 pp.

This report is a review commissioned by the Central Ontario Science and Technology Development Unit in North Bay. It discusses the use of prescribed fire in the Great Lakes-St. Lawrence and deciduous forests. The area that was reviewed comprised 5 former OMNR Regions: Northeastern, Algonquin, Eastern, Central, and Southwestern. The review included a literature review, study of ministry documents, and meetings with staff at 20 locations in 4 programs.

Report
OMNR Library

273. Voigt, D.R. 1992. White-tailed deer habitat in Ontario: background to guidelines. Ont. Min. Nat. Resour., Wildl. Policy Br., Toronto, ON. 5 pp.

Forest management should be geared to maintaining continuous mast production to improve wildlife habitat over the long term on summer ranges where oak and beech occur. Since red oak is a mid-tolerant species, it is most suitable to even-aged silviculture (shelterwood or clearcut). When harvesting is occurring, older trees with large crowns should be left because they are more likely to produce seed. Where shallow soil ridges exist, large mast crops of oak can be produced during difficult growing seasons.

Report
OMNR Library

274. von Althen, F.W. 1962. Hardwood planting: a review of the literature. Can. Dept. For., Richmond Hill, ON.

This report provides a literature review of hardwood planting. Emphasis is on the general problems of planting, such as site selection, site preparation, cultivation, selection of planting stock and seedling practices. Planting practices, cultivation methods, fertilization, and general plantation development are discussed.

Report
Ontario Forest Research Institute (SSI)

275. von Althen, F.W. 1964. Hardwood planting problems and possibilities in eastern Canada. Can. Dept. Fish. For., For. Br., For. Res. Lab., Ont. Reg., Ottawa, ON. Dept. For. Publ. No. 1043. 40 pp.

Hardwood timber accounts for 21% of the total value of annual lumber production in eastern Canada. Hardwoods are presently being harvested from old-growth forests or naturally regenerated stands, and artificial regeneration has been unsuccessful. A review of North American and European literature (discussing hardwood planting) is summarized in this report . Topics covered include site selection, site preparation and cultivation, selection of planting stock, and seeding practices. Recommendations for hardwood plantation establishment in eastern Canada are provided, including planting practices, cultivation methods, fertilization and general plantation development for each species.

Report
Canadian Forest Service Library

276. von Althen, F.W. 1965. Hardwood plantations of southern Ontario. Can. Dept. Fish. For., For. Br., For. Res. Lab., Ont. Reg., Sault Ste. Marie, ON. Inf. Rep. 0-X-2. 44 pp.

As a result of inadequate information being available regarding the performance of different hardwood species planted in southern Ontario, a hardwood plantation survey was established in 1963 and 1964. Diameter and height growth of 17 tree species are listed and the plantations are described. The mean annual height growth of the most commonly sampled species is evaluated in regard to soil, texture, moisture, rooting depth and previous use of the plantation site. Recommendations are proposed for planting site selection of the most commonly planted species. (Also reprinted as von Althen, F.W. 1970. Hardwood plantations of southern Ontario. Can. Dept. Fish. For., Can. For. Serv., For. Res. Lab., Ont. Reg., Sault Ste. Marie, ON. Inf. Rep. 0-X-2. 34 pp.)

Report
Canadian Forest Service Library

277. von Althen, F.W. 1969. Hardwood management in Ontario: an analysis of management and utilization problems in the hardwood forests of southern Ontario. Can. Dept. Fish. For., For. Br., For. Res. Lab., Ont. Reg., Sault Ste Marie, ON. Inf. Rep. 0-X-81. 49 pp.

This report provides background information for the development of a comprehensive hardwood research program in southern Ontario. The economic importance of the hardwood resource, along with a review of the present state of knowledge, and a discussion of management problems is addressed. A serious depletion in high quality timber was reported as a result of excessive exploitation and poor management practices. In 1966, the Ontario Legislature passed the Woodlands Improvement Act, which allows public funds to provide for the expansion and improvement of privately owned woodlots. Unfortunately, literature on managing private woodlots and improving woodlots is not available. von Althen recommended that a new comprehensive research program be implemented, along with a comprehensive management plan for southern Ontario hardwoods.

Report
Canadian Forest Service Library

278. von Althen, F.W. 1969. Proposed planting stock grades for hardwoods planted in Ontario. Can. Dept. Fish. For., For. Br., For. Res. Lab., Ont. Reg., Sault Ste. Marie, ON. Inf. Rep. 0-X-106. 9 pp.

A study was initiated in 1963 that tested the suitability of the following most commonly planted hardwood species in Ontario for afforestation: silver maple, basswood, red oak, and white ash. The experiment was conducted in Grey County, Ontario. A factorial, randomized block arrangement that was replicated 3 times was chosen for the study. Three size classes of planting stock were planted in 3 successive years, with each block being divided into 21 plots. Complete weed control was maintained during the first 3 years by rototilling and manual hoeing. During the fourth year, chemical control was attempted with 5 pounds of Simazine applied in the spring. Each autumn, the seedlings were sprayed with the rabbit repellent Arasan 42S. In the early spring, trees were pruned if necessary. The data that was collected for 3 successive years could not be analyzed because weather conditions varied, along with the size and quality of the planting stock. During the first year, 80% of the mortality occurred within the first 2 months. When 10 pounds of Simazine 50 W was applied in the spring of the fourth year, it proved to be 90% effective in weed control. The applications of Arasan 42S protected all of the trees from browsing damage by snowshoe hares and cultivation prevented mouse damage.

Report
Canadian Forest Service Library

279. von Althen, F.W. 1971. Effects of weed control on the survival and growth of planted black walnut, white ash and sugar maple. For. Chron. 47(4): 223-226

The seedlings in this study were planted on a flood plain of the Ausable River near Parkhill, Ontario. Three studies were carried out to examine the effects of various weed control treatments on the early survival and growth of planted black walnut, white ash, and sugar maple. The fields were plowed and tilled in the autumn, then planting occurred in the spring. In Study 1, 16 black walnut (1 + 0), white ash (2+0), and sugar maple (2+0) seedlings were planted in each treatment in a randomized block arrangement with 4 replications. The treatments consisted of mulching, then rototilling in the first year and 2 years after planting. A single application of Simazine was sprayed shortly after planting. In study 2, 20 black walnut (1+0), white ash (2+0), and sugar maple (2+0) seedlings were planted in each treatment in a randomized block arrangement with 3 replications. The treatments included mulching, and a single application of active Simazine. Study 3 had 9 black walnut (1+0) seedlings that were planted in each treatment

in a randomized block arrangement with 6 replications. The treatments included mulching, and manual weeding after the first year of planting. Weed growth was successfully controlled during the first year. During the third year, the most effective treatment was either implementing 4-ft (1.2 m) wide covers of black polyethylene, 9 and 12 lb/ac (10.1 and 13.4 kg/ha, respectively) dosages of active Simazine or rototilling for 2 years. Survival and growth of sugar maple were unacceptable under all treatments.

Journal paper
OMNR Library

280. von Althen, F.W. 1972. Preliminary guide to hardwood planting in southern Ontario. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. O-X-167. 12 pp.

This report recommends that the following conditions be met for hardwood afforestation in southern Ontario: (1) a deep, moist but well-drained planting soil; (2) intensive site preparation, preferably plowing and discing of the total plantation area; (3) careful planting of healthy, sturdy planting stock; (4) effective weed control for at least the first 2 years after planting; and (5) control of rabbits and mice. Where nutrient-deficient soil occurs, fertilization was suggested. It was estimated that to establish a hardwood plantation under average conditions, the cost would be $110/ac ($271.70/ha).

Report
Canadian Forest Service Library

281. von Althen, F.W. 1973. Hardwood plantation establishment. Pp. 78-89 *in* Management of Southwestern Ontario Hardwoods: Proc. Can. Ont. Joint For. Res. Comm. Symp., April 1973, Richmond Hill, ON. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Symp. Proc. O-P-1. 126 pp.

This paper presents a review of the Canadian Forest Service's hardwood afforestation research program from 1963-1973. The paper includes sections on proper site selection, weed control, planting stock, planting methods, direct seeding, fertilization, rodent control, and future research plans.

Proceedings
MNR Library

282. von Althen, F.W. 1974. Methods for the successful establishment of black cherry plantations in southern Ontario. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. O-X-205. 13 pp.

Seedlings and transplants of black cherry, black walnut, and white ash were planted in a fertile former agricultural field near Parkhill, Ontario to determine the effects of planting stock age, stem clipping and fertilization on tree survival and early height growth. A severe frost in early June of the fourth growing season killed all of the current and previous year's growth of black walnut and white ash seedlings and transplants. Black cherry was not affected by the frost. Age of planting stock had little effect on the survival of all 3 species or on the height growth of black walnut. Height growth of black cherry seedlings was significantly better than transplant growth. Height growth of white ash transplants was significantly better than seedling growth. Stem clipping had no effect on the survival of all 3 species but increased height growth sufficiently to compensate, within 3 to 5 years, for the height lost in clipping. Fertilization had no effect on the survival or height growth of the 3 species. Recommendations are made for the successful establishment of black cherry plantations in southern Ontario.

Report
Canadian Forest Service Library

283. von Althen, F.W. 1974. Successful establishment of sugar maple in a Scots pine plantation. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste Marie, ON. Inf. Rep. O-X-208. 7 pp.

This study occurred near St. Marys, Ontario and involved sugar maple seeding and planting in a 23-year-old Scots pine plantation. The 4-year height growth of the seedlings was only 27 cm (10.53 inches), and

only 2% of the viable seed germinated. Survival of planted seedlings and transplants ranged from 79 to 96% for the 4-year period. In plots where 2 rows of Scots pine were removed for each row left standing, the growth during this 4-year period for the 2+0 seedlings and the 2+1 and 2+2 transplants was 77, 150, and 152 cm (19.6, 38.1 and 38.6 inches, respectively).

Report
Canadian Forest Service Library

284. von Althen, F.W. 1977. Planting sugar maple: fourth-year results of an experiment on two sites with eight soil amendments and three weed control treatments. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-257. 13 pp.

This study took place in Middlesex County, Ontario and involved planting 2-year-old sugar maple (*Acer saccharum* Marsh.) seedlings in sandy loam and clay loam soils. The fields were plowed and disked in the summer and autumn previous to the spring planting. There were 8 amendments times 3 weed control treatments. Two methods were used for planting: the first involved placing hardwood leaves, pine needles, peat moss, or fertilizer in the bottom of planting holes. The second involved placing fertilizer in a hole beside the seedlings or spreading the fertilizer on the soil surface around the seedlings. Weeds were controlled using (1) rototilling and hoeing; (2) spraying Gramoxone on the vegetation growing in a circle 60 cm (2 ft) in a diameter around the tree seedlings; or (3) mowing 4 times per year in each of the first 4 years after planting. Plowing and discing the total plantation area in the summer and autumn before spring planting was recommended. von Althen also suggested planting in April; rototilling and hoeing at least 4 times per year for the first 3 years after planting; and protecting seedlings from deer, rabbits, and mice.

Report
Canadian Forest Service Library

285. von Althen, F.W. 1977. Weed control with Simazine revitalizes growth in stagnating hardwood plantations. Can. Dept. Fish. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-261. 20 pp.

Three studies on red oak, black walnut, basswood, and white ash were conducted near Thedford and Hornby in southern Ontario. The focus of these experiments was to determine the effectiveness of chemical applications in revitalizing the growth of stagnating plantations. When Simazine was applied (dosages of 3.4-9.0 kg/ha) in 2 successive years, 5 to 8 years after planting, height growth increased significantly in most of the trees. Where dense weed growth occurred, soil moisture was much lower than in soils without weeds. The highest nitrogen concentrations were found in the leaves of trees growing in the treated weed-free plots.

Report
Canadian Forest Service Library

286. von Althen, F.W. 1979. Preliminary guide to site preparation and weed control in hardwood plantations in southern Ontario. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. O-X-288. 28 pp.

The necessity of site preparation and post-planting weed control for successful establishment of hardwood plantations is discussed. The results of a series of experiments, carried out in southern Ontario, show that the best method of site preparation is the elimination of weed cover by one application of 4.7 L/ha (0.5 U.S. gal/ac) of Roundup in late summer followed by plowing and discing of the total plantation area. Where treatment of the total area is impossible or inadvisable it is best to plow and disc strips after spraying them with Roundup. Following site preparation and planting, annual applications of 3.4 to 5.6 kg/ha (3 to 5 lb/ac) of Princep 80W keep the plantations relatively weed free until the trees outgrow the competition. Other site preparation and post-planting weed control treatments are described in detail and the cost of all treatments is estimated.

Report
Canadian Forest Service Library

287. von Althen, F.W. 1980. Five-year survival and growth of sixteen hardwood species planted in different mixtures. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-313. 13 pp.

This study was located near Parkhill, Middlesex County, Ontario and involved 16 hardwood species that were planted in different species mixtures. There were 2 experiments that occurred in a former field with sandy loam soil. Tree heights were measured 5 years after planting. Height growth ranged from 39 to 469 cm (similar to seedlings planted in pure plantations). Five-year survival rates were 44 to 99%. Row plantings were found to be more efficient for average survival and height growth than in a completely random plot. Most of the trees required pruning since they were spaced 3 x 1.5 m to ensure stems would have veneer quality. Closer spacing should be implemented on future plantations to ensure proper stem form, branch development, and crown closure.

Report
Canadian Forest Service Library

288. von Althen, F.W. 1983. Animal damage to hardwood regeneration and its prevention in plantations and woodlots of southern Ontario. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep 0-X-351. 28 pp.

This paper discusses mammal browsing damage to natural and artificial regeneration caused by mice, squirrels, rabbits, snowshoe hares, European hares, groundhogs, deer, and cattle in hardwood plantations and wood lots. Possible control methods and their relative effectiveness are described and estimates are provided on the cost of the most promising controls.

Report
Canadian Forest Service Library

289. von Althen, F.W. 1983. Effects of age and size of sugar maple planting stock on early survival and growth. Tree Plant. Notes 34(3): 31-33.

Age and size had little effect on the survival and height growth of bareroot seedlings and transplants. Survival and growth of containerized seedlings were significantly lower than those of bareroot stock. Sugar maple seedlings and transplants were planted in 1976, 1977, and 1978. This paper reports the 6-, 5-, and 4-year results of these studies. Significantly lower survival of containerized seedlings was probably due to the seedlings being small — they were grown in unsuitable containers and improper production methods were used. Until seedling quality has been improved, it is recommended that only bareroot seedlings or transplants be planted. There was no significant difference in height growth between seedlings and transplants. In study 1, the growth of 2 + 3 transplants was influenced by their being planted in auger holes. Trees with large root collar diameters grew taller than trees with small root collar diameters. Excellent weed control contributed to the good survival and growth of the nursery-grown stock. For the establishment of plantations, machine planting of sturdy 2- or 3-year-old seedlings was recommended. For plantations where the height of trees is important, the planting of large transplants in auger holes was suggested.

Journal paper
OMNR Library

290. von Althen, F.W. 1983. Planting and tending recommendations for sugar maple. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. 2 pp.

Recommendations are summarized on suitable planting locations for sugar maple. Tips on site preparation, species mixtures, and spacing are discussed. The types of planting stock, when to plant, and the method of planting are also covered. Finally, weed control after planting, fertilization, and rodent control are addressed.

Report
Canadian Forest Service Library

291. von Althen, F.W. 1984. Mowing versus mechanical or chemical weed control in sugar maple afforestation. Tree Plant. Notes 35(3): 28-31.

This report presents the results of a study that compared mowing with the chemical and mechanical elimination of herbaceous vegetation on the 10-year survival and growth of planted sugar maple seedlings. The plots were mowed 4 times a year for 9 years or rototilled for 4 years and sprayed with Simazine for 5 years. The 10-year cumulative height increments of planted sugar maple were 156 and 366 cm. By eliminating competing vegetation with applications of propyzamide and Simazine, height increments soared in one year. This was more productive than mowing for 4 years. After this study, more research will be required to determine the processes of weeds interfering with tree growth. Mowing was not as efficient as mechanical or chemical elimination of weeds because herbaceous competition was not removed.

Journal paper
OMNR Library

292. von Althen, F.W. 1985. Spacing trials in black walnut, white ash and silver maple plantations. Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-365. 14 pp.

Black walnut seedlings were planted at spacings of 3 x 1.5 m, 3 x 3 m, 4.5 x 3 m and 4.5 x 4.5 m near Norwich, Ontario while white ash and silver maple were planted at spacings of 1.85 x 1.85 m, 2.75 x 2.75 m, and 3.65 x 3.65 m near Parkhill, Ontario. Chemical weed control in all plantations consisted of applications of Simazine shortly after planting and in April of the next year or two. Double leaders were pruned in years 2 and 4. Ten years after planting, spacing had no significant effect on the survival, diameter and height growth of black walnut and white ash or the survival and height growth of silver maple. Only the diameter growth of silver maple was significantly greater in the widest spacing than in the 2 narrower spacings. Stem form of black walnut and silver maple was superior in the narrowest spacings while stem form of white ash was unaffected. Recommendations are made for spacing of black walnut, white ash, and silver maple seedlings in intensively and extensively managed plantations.

Report
Canadian Forest Service Library

293. von Althen, F.W. 1986. Effects of planting date on outplant performance of cold-stored and fresh-lifted black walnut, red oak, and silver maple seedlings. Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. Inf. Rep. 0-X-374. 9 pp.

This study took place in Parkhill, in southwestern Ontario, and involved black walnut, red oak, and silver maple seedlings. After being cold stored and fresh-lifted, the seedlings were planted at 2-week intervals from 21 April to 16 June. The fresh-lifted species that were planted in June had reduced 3-year survival, however, June planting did not have the same effect on overwinter cold-stored seedlings. Seedlings planted in early May had the highest 3-year height increment, while seedlings planted in June grew least. If seedlings that were planted in June were overwinter cold stored, they were assured high survival, however, their height increment was lower than that of the fresh-lifted and cold-stored stock that were planted before the end of May. In all 3 species, fresh-lifted stock that were planted in June had reduced survival and height increments.

Report
Canadian Forest Service Library

294. von Althen, F.W. 1988. Effects of spatial arrangement in mixed-species hardwood plantations. J. For. 5(3): 203-207.

This study took place in a former field with imperfectly drained silt loam soil in Middlesex County, Ontario. Two experiments were performed on 16 planted hardwood species. Planting arrangement had minor effects on their 10th-year survival, height growth, and diameter growth. A random species mixture was slightly better

for survival and growth. Adequate weed control was achieved by applying 3.3 kg/ha of active Simazine during the first 3 years after planting. During the sixth growing season, glyphosate eliminated 80% of the competition, renewed tree vigour, and enabled trees to close the canopy. Several suggestions and recommendations are made for establishing mixed hardwood plantations.

Journal paper
OMNR Library

295. von Althen, F. 1990. Establishing quality hardwoods. , Ont. Min. Nat. Resour., Fast Growing Forest Group, Brockville, ON. FGF Online

Proceedings from a seminar hosted by the FGF Group are presented. The focus of this seminar was to provide an awareness of the several technologies available to successfully establish hardwood plantations. Fred von Althen provided suggestions to increase the hardwood component in southern Ontario. He believed that we could gain 30 to 40 years through the management of existing stands. Other speakers from the seminar included L. Auchmoody and George Stroempl. Video coverage of the 3 presentations is also available from the FGF Group.

Report
Ontario Forest Research Institute (SSI)

296. von Althen, F.W. 1990. Hardwood planting on abandoned farmland in southern Ontario: revised guide. For. Can., Ont. Reg., Sault Ste. Marie, ON. 77 pp.

*A guide to hardwood planting on abandoned farmland in southern Ontario* was first published in 1979. In the past 10 years, much new knowledge has been gained about species requirements and new techniques have been developed for successful plantation establishment. This revised guide presents the most up-to-date information on the general conditions necessary for successful establishment of 10 major and 15 minor plantation species.

Books and guides
Canadian Forest Service Library

297. Wagner, R.G., Buse, L.J., Lautenschlager, R.A., Bell, F.W., Hollstedt, C., Strobl, S., Morneault, A.E., Lewis, W., Ter-Mikaelian, M.T. 1995. Treatment alternatives. Pp. 16-43 *in* Vegetation management alternatives program: 1994-1995 annual report. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. 99 p.

This section of the Vegetation Management Alternatives Program Report covers various treatment alternatives that apply to tolerant hardwoods. Studies reported on include the annual burn cycle - Bracebridge, biennial burn cycle - Carleton Place, effects of site preparation on yellow birch regeneration, regeneration of northern red oak using shelterwood harvest with prescribed understorey burning or herbicides. There is also an experiment titled *Chatham black cherry natural regeneration study*. Findings from the red oak and sugar maple mulch trials in the southern region are described. Experiments with red oak and tree shelters are described.

Report
Ontario Forest Research Institute

298. Wagner, R.G., Colombo, S.J. (eds.). 2001. Regenerating the Canadian Forest: Principles and Practice for Ontario. Fitzhenry and Whiteside Ltd., Markham, ON. 650 pp.

This book was undertaken to synthesize and summarize the tremendous progress that has been made by generations of foresters and forest researchers in regenerating the Canadian forest. The book is divided into 8 parts, each organized around a major topic relevant to forest regeneration. The book provides a comprehensive literature review and synthesis of the principles and practice of forest regeneration, with special reference to the province of Ontario. It is intended as a guide for practicing foresters, forestry students, wildlife biologists, and others who wish to understand reforestation problems and feasible solutions and includes a chapter on hardwood managment.

Books and guides
OMNR Library

299. Walker, J.D. 1989. Ontario Tree Improvement and Forest Biomass Institute trial/plot register, December 1988. Ont. Min. Nat. Resour. 18 pp.

This publication is a directory of the Ontario Tree Improvement and Forest Biomass Institute's research stations and project locations throughout the province of Ontario as of December 1988.

Report
Ontario Forest Research Institute

300. Wang, B.S.P. 1964. Diameter, height and age relationships of sugar maple and yellow birch in the Goulais River Area, Ontario. Univ. Toronto, Toronto, ON. Project 0-13. 14 pp.

This study occurred in the Goulais River Research area in Algoma Forest District, Ontario. Growth relationships between diameter, height, and age of sugar maple and yellow birch in uneven-aged tolerant hardwood and tolerant mixedwood stands are examined. The focus of this experiment is to determine if conventional height-age and height-diameter growth ratios are feasible for site quality evaluation in these stands. Sugar maple showed a lower average height growth rate than the yellow birch because it has a longer juvenile growth stage. Yellow birch showed a height growth difference of 10 ft (3.0 m) between the 2 sites from 40 years to maturity. Diameter growth of sugar maple is influenced more by stand density than by site quality. Yellow birch appeared to respond to both of these factors equally. Site indexes are illustrated for the yellow birch stands.

Report
Petawawa Research Forest

301. Wang, B.S.P. 1965. Seedbed, canopy and moisture effects on growth of yellow birch seedlings. For. Chron. 41(1): 106-107.

Yellow birch requires adequate height growth and concomitant root development in the early stages when regenerating in hardwood stands. In this study, height growth of young birch has been reported as related to canopy density, seedbed conditions, microsite moisture regime, browsing injury and competition. To test the influence of seedbed condition and canopy density on height growth of yellow birch seedlings, a study was conducted in the Goulais River Research Area, 45 miles northeast of Sault Ste. Marie, Ontario, in a tolerant hardwood stand treated by canopy reduction and ground scarification to obtain yellow birch regeneration. A record was kept of 82 tagged yellow birch seedlings for 2 years on 52 randomly selected milliacre quadrats growing on sandy loam overlying washed till. Soil moisture, canopy density and seedbed condition were noted.

Journal paper
OMNR Library

302. Wang, B.S.P. 1968. The development of yellow birch regeneration on scarified sites. Can. Dept. For. Rural Devel., For. Br., Ottawa, ON. Dept. Publ. No. 1210. 14 pp.

In this early (1953) operational trial to regenerate yellow birch in cutover tolerant hardwood stands in Ontario, heavy cutting and ground scarification proved to be highly effective in increasing yellow birch content. The trial took place in Haliburton County on a well drained loam till soil which varied in depth. Four 10-ac blocks (4.0 ha) (2 for control) were chosen for treatment. Logging occurred from late September to early October in 1953. After logging, 60% of the residual stand volume was girdled to provide 30 to 40% shade at ground level. The canopy density averaged 40% on the treated and 83% on the control blocks 3 years after the girdling. Almost 47% of the treatment area was scarified, while 15% of the control block area was scarified. Despite heavy browsing by deer, yellow birch dominates 23% of the quadrats and occurs on an additional 43%. Ultimately it is expected to dominate approximately 30% of the stand. These dominants have a height range between 10 and 25 ft (3 and 7.6 m, respectively) 10 years after treatment. Any release treatment applied to the stands now would further increase the yellow birch component.

Report
Canadian Forest Service Library

303. Wargo, P.M., Parker, J., Houston, D.R. 1972. Starch content in roots of defoliated sugar maple. For. Sci. 18(3): 203-204.

This paper examines how starch levels in sugar maples roots were reduced only in those trees defoliated severely enough to cause refoliation in the same season. The amount of starch reduction in individual trees varied. Both degree and frequency of defoliation reflected starch content.

Journal paper
OMNR Library

304. Watson, N.F. 1985. An evaluation of yellow birch and hard maple regeneration, in strip clear cuts of Parkinson Township, to determine an optimum season of harvest. Lakehead Univ., For. Dept., Thunder Bay, ON. B.Sc.F. Thesis. 45 pp.

This study took place in the northwest corner of Parkinson Township in the District of Blind River. The main focus of the experiment was to determine the most appropriate season of logging to promote yellow birch regeneration. Strip clearcuts were harvested in 3 seasons, summer to early fall, fall, and winter for quality stocking of yellow birch and hard (sugar) maple. Results indicated that none of the harvest seasons examined provided significantly high stocking of yellow birch. Summer logging was recommended to provide the best seedbed conditions for yellow birch. The following recommendations were provided for increasing the proportion of yellow birch in the strip cuts: cut in the fall, scarify the strips in late fall after harvesting.

Thesis
Lakehead Univ. Library

305. Watt, J. 1996. Anthropogenic fire: a new perspective on the fire/oak connection. Ont. Min. Nat. Resour., Ont. For. Res. Inst., Sault Ste. Marie, ON. Insights 1(2):4-6.

This article describes research that looks at the fire scars on tree stumps, documenting historic fire chronologies that can be correlated with the recorded history of native and early European movement/occupation in the area.

Report
Ontario Forest Research Institute

306. Webb, D.P. 1974. Effects of competition on microclimate and survival of planted sugar maple (*Acer saccharum* Marsh.) seedlings in southern Ontario. Can. Dept. Env., Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste Marie, ON. Inf. Rep. 0-X-209. 14 pp.

This open field study is located in southern Ontario, with the objective of determining the effects of competition on the survival of potted and bareroot seedlings of sugar maple. If competing vegetation consisting mainly of quack grass, wild carrot, and golden rod was removed, it increased significantly seedling survival. The most successful treatment in the study involved planting container-grown seedlings with their peat pots removed and the soil ball intact in areas without competition. Significant differences in microclimates were observed between areas with and without competition. Also, soil moisture increased significantly when there was decreased absorption of solar radiation, decreased maximum temperatures, and an absence of transpiring vegetation.

Report
OMNR Library

307. Webb, D.P. 1977. Root regeneration and bud dormancy of sugar maple, silver maple and white ash seedlings: effects of chilling. For. Sci. 23(4): 229-238.

This study took place on St. Joseph Island, approximately 48 km east of Sault Ste Marie, Ontario. The effects of chilling on root growth and bud dormancy of cold-stored and nursery-lifted 2-0 silver maple, white ash, and sugar maple seedlings were investigated. Silver maple required the fewest hours (2,000-2,500) to break bud dormancy, while sugar maple and white ash required between 2,500-3,000 hours. There was a strong correlation between root regeneration, time to first bud break, and number of hours of chilling for all species. New root

development occurred between November and May for all species. The amount of chilling or state of bud dormancy did not appear to affect this new root development. In all species, the greatest amount of root regeneration occurred after 3,500 hours of chilling. For example, sugar maple showed a decrease in root regeneration. Silver maple and white ash seedlings regenerated more roots than sugar maple seedlings.

Journal paper
OMNR Library

308. Webb, D.P., von Althen, F.W. 1980. Storage of hardwood planting stock: effects of various storage regimes and packaging methods on root growth and physiological quality Can. For. Serv., Grt. Lks. For. Res. Cent., Sault Ste. Marie, ON. 13 pp.

Two experiments were conducted between 1977 and 1979 on the overwinter storage of 7 temperate zone hardwood species commonly planted in southern Ontario. Planting stock quality can be markedly affected by storage temperature and packaging method. Overall growth potential and root growth capacity of cold-stored stock at 0.5 and 5°C were comparable with those of normal spring-lifted controls. Root growth capacity of stored seedlingsthat were significantly correlated with shoot xylem water potential at time of removal from storage included the following: sugar maple, silver maple, American basswood, white ash, red oak, black walnut, and paper birch. Autumn-lifted nursery stock of all but black walnut can be stored at a temperature of 0.5°C. Walnut should be stored at 5°C with a relative humidity of 70 to 85%. Moist peat should surround the roots and the total seedling within a Kraft bag with a polyethylene liner.

Report
Ontario Forest Research Institute (SI)

309. Weber, M.G., Taylor, S.W. 1992. The use of prescribed fire in the management of Canada's forested lands. For. Chron. 68(5): 324-334.

Current methods of prescribed burning in Canada are discussed. Fire is an obvious choice for a management tool because it has been a natural component in forests. There are 6 categories for prescribed fire based on desired outcome: (1) hazard reduction; (2) silviculture (site preparation, vegetation management, stand conversion, and stand rehabilitation); (3) wildlife enhancement; (4) range burning; (5) insect and disease control; and (6) conservation of natural ecosystems. The history of prescribed fire, which includes the area burned under prescription by province and territory, is presented. Prescribed fire appears to be an asset to park management objectives; it is compatible with wildlife objectives and is cost effective.

Journal paper
OMNR Library

310. Westwind Forest Stewardship, Inc. 2000. The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

This binder contains keynote speaker and field trip notes, contacts, and additional resources for a conference on *The ecology, silviculture and management of Great Lakes - St. Lawrence oak*. During the first day of the conference, seminars included the importance of oak to wildlife and the landscape, collection and storage of acorns, growth of seedlings, and repeated burning trials. A field trip included stops to visit regenerating oak-burn trials, shelterwood operations, and strip cut operations. On the second day of the conference, growth, physiology, shelterwood management, harvesting, and prescribed burns were discussed. The Andy Gordon Oak Research Trial and a 2-burn operational treatment were visited during the field tour. The third day of the conference involved a trip to Watt Lake, Papineau Lake, Yuill Lake and the Dan Dey/Bill Parker Oak Trial.

Proceedings
Ontario Forest Research Institute (SSI)

311. Wilson, T. 2000. The establishment of red oak in plantations: a comparison of container and bareroot stock types. *In* The Ecology, Silviculture and Management of Great Lakes-St. Lawrence Oak: Proceedings of the Your Forest - Your Choice Conference Series, Part 7, Nov. 1-3, 2000, Bracebridge, ON. Westwind For. Steward., Inc. 95 pp.

In this study, the performance of bareroot and container stock types of red oak on a typical restock site in central Ontario are examined. Container stock exhibited superior performance due to differences in root architecture. Container seedlings that had a large root surface area, combined with rapid root development could quickly overcome the effects of planting stress. The bareroot seedlings had low root fibrosity. This was due to the seedlings becoming drought stressed as a result of insufficient root surface area and their inability to receive moisture when their shoots were developing in the spring. Container systems are excellent for producing high quality red oak planting stock. Plants grown in Jiffypots had good root system development and high fibrosity, which is believed to contribute to a high degree of uniformity, rapid early growth, and high survival rates relative to the bareroot stock.

Proceedings
Ontario Forest Research Institute (SSI)

312. Watlaw, H., Naylor, B.J., Bellhouse, T. 1993. The influence of residual stocking and time since harvest on winter browse supply for white-tailed deer. Ont. Min. Nat. Resour., Cent. Ont. Sci. Technol. Devel. Unit., North Bay, ON. Tech. Rep. No. 32. 8 pp.

Preliminary curves are presented that predict browse supply for deer in the tolerant hardwood forest of central Ontario in relation to residual stocking and time since harvest. Heavy selection cuts (residual basal area 12-14 $m^2$/ha) produce a greater biomass of browse for a longer period of time (initially) than moderate or light selection cuts (residual basal area 16-20 $m^2$/ha). However, the amount of browse available per year (averaged over the cutting cycle) is the same regardless of the intensity of harvest because heavy cuts extend the cutting cycle.

Report
OMNR Library

313. Wood, J.E., von Althen, F.W., Mitchell, E.G. 1996. Crown release improves growth of 20-year-old *Betula alleghaniensis* in tolerant northern hardwood stands. New For. 12: 87-99.

This study involves the thinning of a sugar maple and yellow birch stand near Thessalon, Ontario, that had previously been strip clearcut. Crop tree selection released approximately 150 to 250 crop trees/ha. A control treatment (no cutting) was included in the design, as well as treatments that removed competing trees at 1, 2, 3, or 4 m around crop tree boles. A positive correlation was found between thinning level using the bole-touching method and the size of the opening available for expansion of the crop tree after thinning. Crop tree crown area available for expansion was found to be more strongly correlated to crop tree diameter, clear bole, and crown increment than to thinning level using the fixed distance from the stem. Five years after thinning, crop tree mortality was low. Diameter increment was positively correlated with area available for crown expansion. The correlation between height increment and the size of canopy opening was weak. Some problems were encountered in the selection of appropriate crop trees due to a lack of experience and training of the thinning crews. Providing a 15 $m^2$ opening around crop tree crowns (with a 30% thinning intensity) balances diameter increment and stem quality.

Journal paper
Ontario Ministry of Natural Resources Library

314. Woods, M.E., Miller, R.J. 1989. Maple 1: A sugar maple growth model, user's manual. Ont. Min. Nat. Resour., For. Manage. Br., Mens. Unit, Sault Ste. Marie, ON. 25 pp.

From 1967 to 1978, 258 hardwood permanent sample plots (PSPs) were

established in southern, central and eastern Ontario. They have been remeasured on an approximate 5-year cycle since establishment. In 1988, the Mensuration Unit of the Ontario Ministry of Natural Resources undertook an evaluation of these plots by compiling the plot data necessary to construct a growth model. The results of this evaluation are contained in Maple 1, a diameter distribution model for sugar maple. Since imperial measure is still commonly used in tallying hardwood trees and lumber, Maple 1 accepts input and presents output in imperial units.

Report
Ontario Forest Research Institute (Cole)

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